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Personal
Computer

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AUSTRALIA'S LEADING MICRO MAGAZINE

BASIC COMPILER

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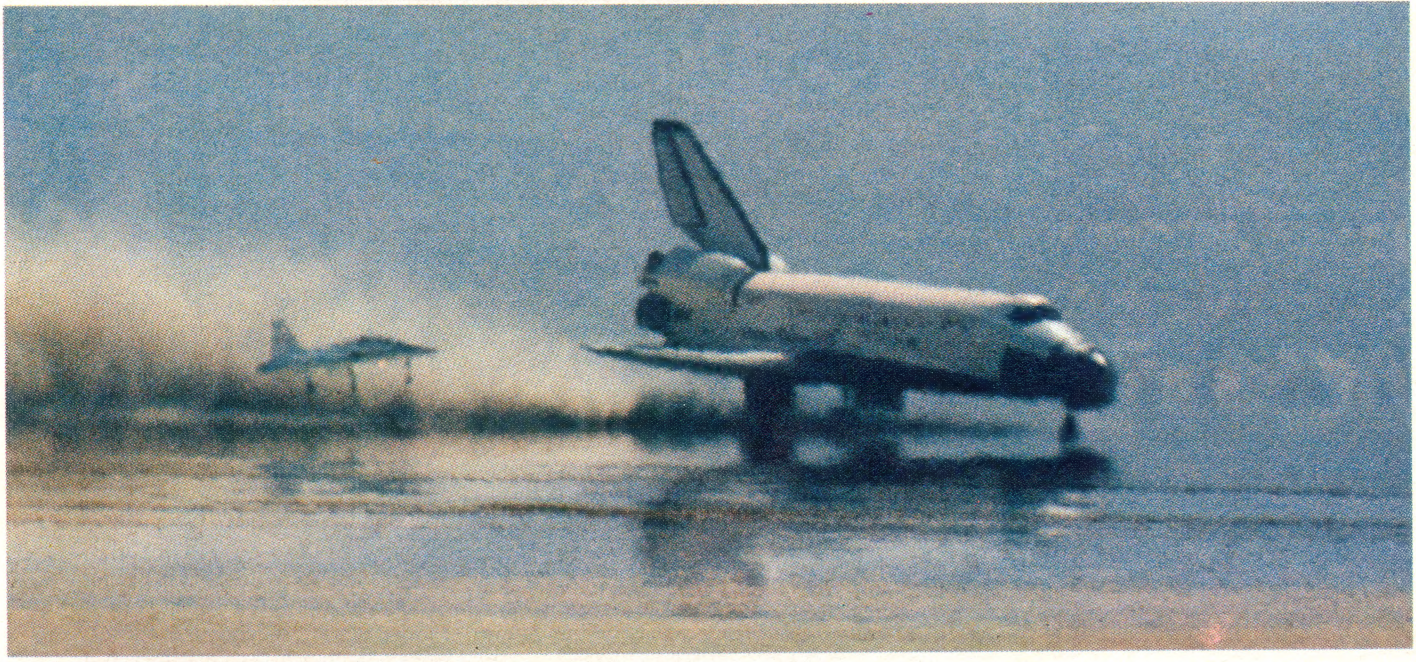
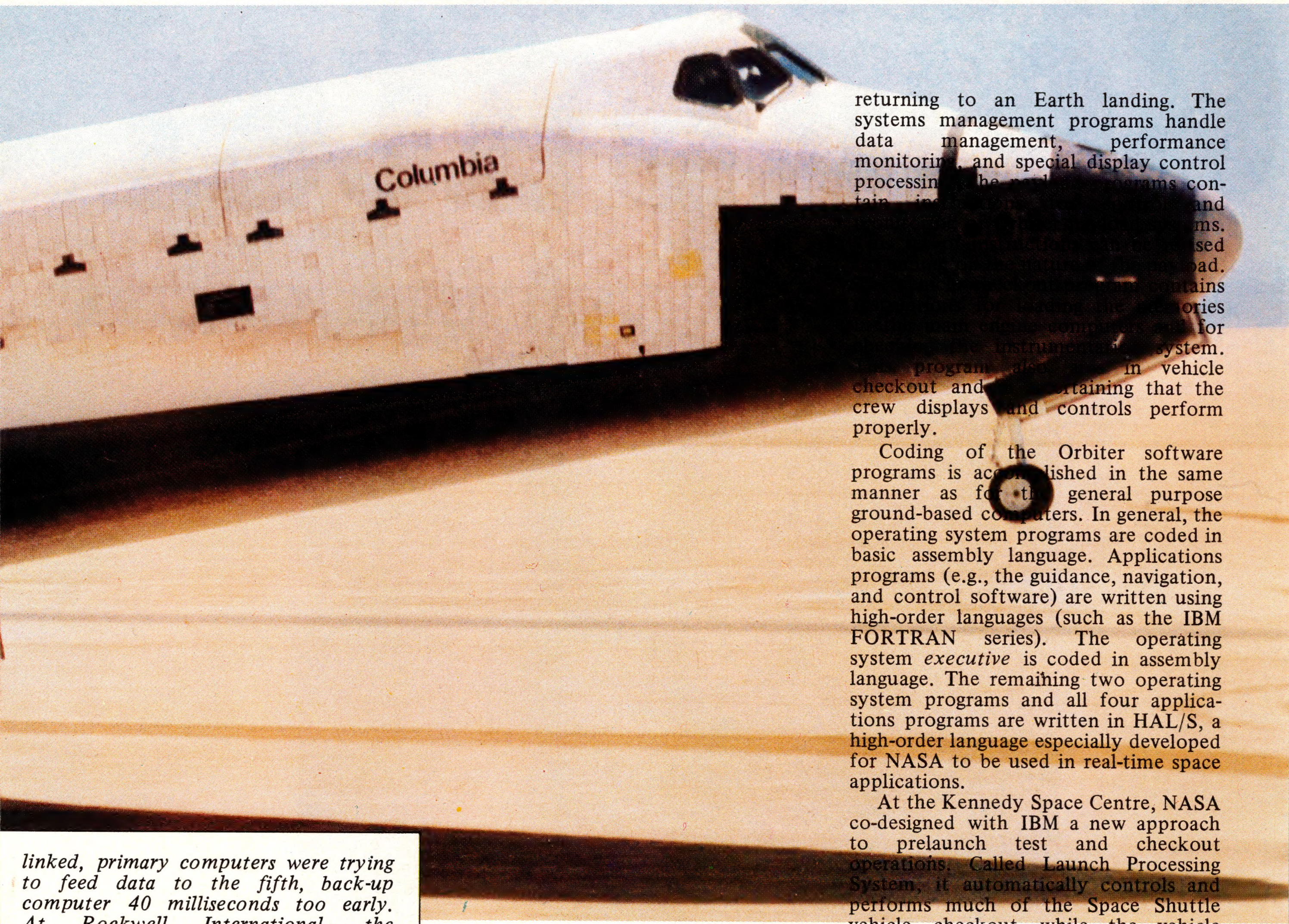


Computers and the Shuttle

d the Shuttle

nedy Space Centre, NASA.



Photograph courtesy of Time Magazine.

linked, primary computers were trying to feed data to the fifth, back-up computer 40 milliseconds too early. At Rockwell International, the company which designed the computer program, a spokesman explained, "When the back-up computer detects a flaw such as an early attempt at communication, it simply hangs up the phone."

entry, and aborts.

The Orbiter software for a major mission phase must fit into the 106,496-word central memory of each computer. To accomplish all the computing functions referred to (for all phases) would require approximately 400,000 words of computer memory. To fit the software needed into the computer memory space available, computer programs have been subdivided into nine memory groups corresponding to the functions executed during specific and checkout phases. For example, one memory group accommodates final countdown, ascent, and aborts; another, orbital operations; and yet another, the entry and landing computations. The computers are loaded with different memory groups from magnetic tapes containing the desired programs. In this way, all the software needed can be stored in mass memory units (tape machines) and loaded into the computers only when actually needed.

The programs are written in a hierachy that contains two levels. The first is the system software group which consists of three sets of programs: (1) the flight computer operating program (the *executive),* which controls the processors, monitors key system parameters, allocates computer resources, provides for orderly program interrupts for higher priority activities, and updates computer memory; (2) the user interface program, which provides instructions for processing crew commands or requests; and (3) the system control program, which initializes each computer and arranges for multicomputer operation during critical flight periods. The system software group programs also tell the computers how to perform and how to communicate with the other equipment.

The second level of memory groups is the applications processing software. This group contains specific software programs for guidance, navigation and control, systems management; payload operations; and vehicle checkout. The two program groups are combined to form a memory configuration for a specific mission phase. The guidance, navigation and control programs contain functions required for launching, flying into orbit, manoeuvring on orbit and returning to an Earth landing. The systems management programs handle data management, performance monitoring, and special display control processing. The payload programs contain [illegible] and [illegible] ms. [illegible] sed [illegible] oad. [illegible] ains [illegible] ories [illegible] for [illegible] instrumentation system. [illegible] program also [illegible] in vehicle checkout and ascertaining that the crew displays and controls perform properly.

Coding of the Orbiter software programs is accomplished in the same manner as for the general purpose ground-based computers. In general, the operating system programs are coded in basic assembly language. Applications programs (e.g., the guidance, navigation, and control software) are written using high-order languages (such as the IBM FORTRAN series). The operating system *executive* is coded in assembly language. The remaining two operating system programs and all four applications programs are written in HAL/S, a high-order language especially developed for NASA to be used in real-time space applications.

At the Kennedy Space Centre, NASA co-designed with IBM a new approach to prelaunch test and checkout operations. Called Launch Processing System, it automatically controls and performs much of the Space Shuttle vehicle checkout while the vehicle components are being prepared for launch. It also provides capability for work order control and scheduling and conducts countdown and launch operations.

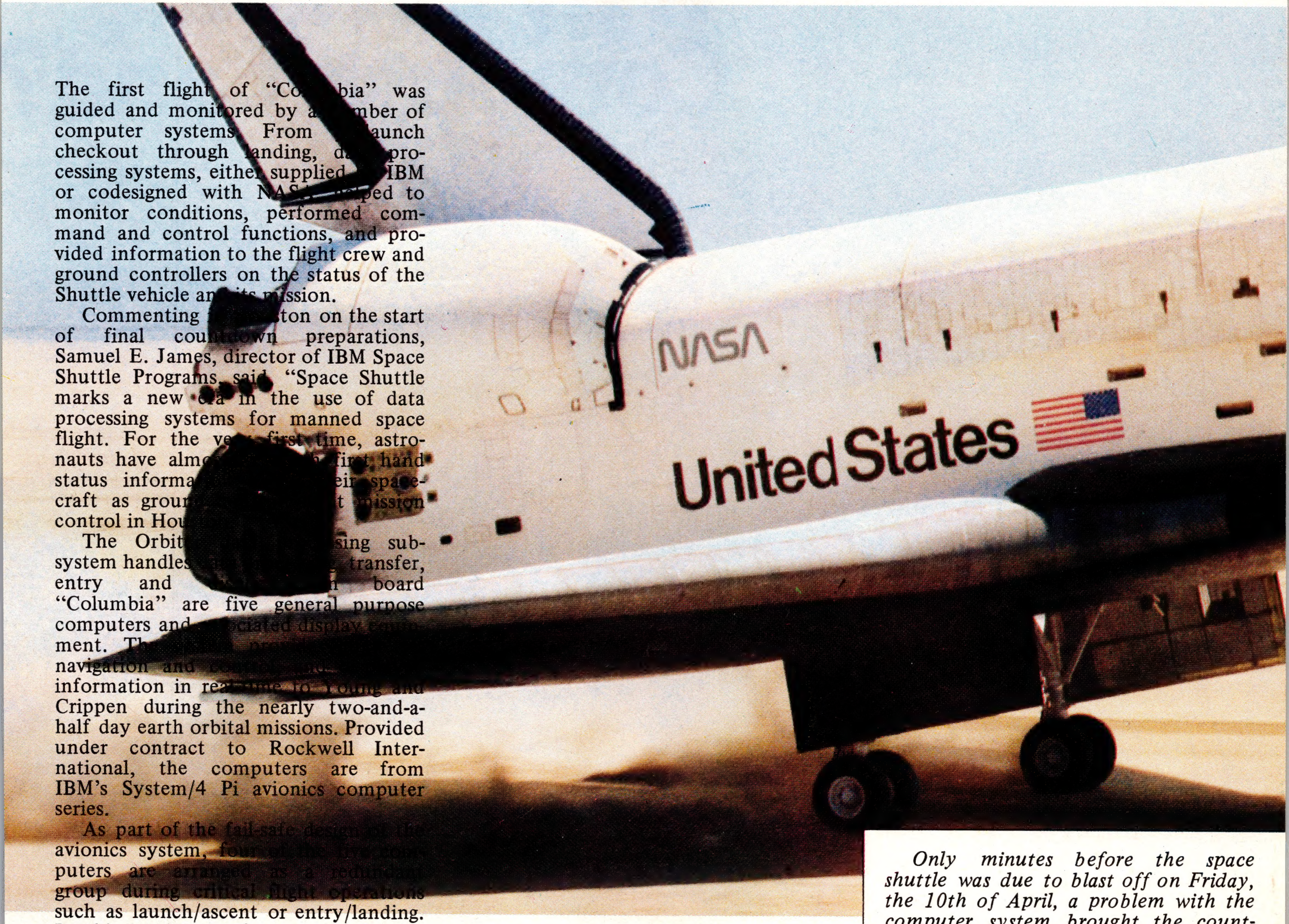
The launch processing system has been designed into the central data subsystem (CDS) and the checkout, control, and monitor subsystem (CCMS). The control data subsystem consists of two large-scale computers (Honeywell H-6680) that store test procedures, vehicle processing data, a master program library, historical data, pre- and post-test data analyses, and other data.

For these launch processing operations, IBM provides 1.8 million instructions, which are used to tie the minicomputer, console displays and associated equipment into a single network.

Once "Columbia" left the launch pad, flight controllers at NASA's Mission Control Center used three IBM/System 370 computers and associated communications equipment to track and monitor the mission. This large real-time complex with 1.7 million computer instructions monitors in-flight conditions, computes and verifies spacecraft manoeuvres, and performs command and control functions during the flight. The computers provide three times more data processing capability than was available for the Saturn/Apollo missions.

Computers and

A special report from The Ken



Only minutes before the space shuttle was due to blast off on Friday, the 10th of April, a problem with the computer system brought the countdown to a standstill. Two days later, dozens of computer experts had isolated and corrected the problem. A timing error of 40 milliseconds (1/25 of a second) had kept Columbia grounded. NASA announced that two of the four,

The first flight of "Columbia" was guided and monitored by a number of computer systems. From [illegible] launch checkout through landing, data processing systems, either supplied [illegible] IBM or codesigned with NASA, helped to monitor conditions, performed command and control functions, and provided information to the flight crew and ground controllers on the status of the Shuttle vehicle and its mission.

Commenting [illegible]ston on the start of final countdown preparations, Samuel E. James, director of IBM Space Shuttle Programs, said, "Space Shuttle marks a new era in the use of data processing systems for manned space flight. For the very first time, astronauts have alm[illegible] first hand status informa[illegible] their spacecraft as groun[illegible] at mission control in Hou[illegible]

The Orbit[illegible]sing subsystem handles [illegible] transfer, entry and [illegible] board "Columbia" are five general purpose computers and associated display equipment. The [illegible] provide navigation and [illegible] information in real-time to Young and Crippen during the nearly two-and-a-half day earth orbital missions. Provided under contract to Rockwell International, the computers are from IBM's System/4 Pi avionics computer series.

As part of the fail-safe design of the avionics system, four of the five computers are arranged as a redundant group during critical flight operations such as launch/ascent or entry/landing. In this mode, the four computers are linked as a voting set with each one capable of being used as the flight control computer and with each one checking on the other three. The crew can select which of the four computers is in control. The fifth computer is used for the back-up flight control system, which would control the Shuttle should all four voting computers fail.

Each of the four computers in the redundant set synchronizes itself to the other three 440 times each second. In this way, the computer set is able to achieve a high degree of reliability. During noncritical flight periods, one computer is used for guidance, navigational and control tasks and another for systems management. The remaining three can be used for payload management or can be deactivated.

During critical phases of a mission, each of the five computers in the system performs approximately 325,000 operations each second using floating-point arithmetic. The crew can ask more than 1,000 questions of the system and have information displayed as alphanumeric symbols, as graphs, or as a combination of the two (including moving and flashing characters or symbols) on any of the four television display sets.

Use of the five operating systems aboard "Columbia" is called "digital fly-by-wire", whereby astronaut commands – converted to electric signals – are sent to the digital computers for processing, and then sent out to control jets, the rudder and other surfaces and devices on the spacecraft.

In addition to the central memory stored in the computers themselves, 34 million bits of information are also stored in two magnetic-tape devices. Critical programs and data are loaded in both tape machines and are protected from erasure. Normally, one mass memory unit is activated for use and the other is held in reserve for operation if the primary unit fails. However, it is possible to use both units simultaneously on separate data buses or to have both communicate with separate computers.

Time-shared serial-digital data buses (essentially party lines) accommodate data traffic between the computers and other Orbiter subsystems. The data bus network consists of digital data signal paths between the computers and the avionics subsystems and secondary channels between the telemetry system and the units that collect instrumentation data. This system is also fail-safe.

Twenty-four data buses are on the Orbiter and an additional twenty-eight buses connect the Orbiter avionics with the Solid Rocket Boosters and the External Tank.

Nineteen multiplexer-demultiplexer units convert and format data at various remote locations of the Orbiter. They act as translators, putting information on or taking it off the data buses.

Software

Controlling the onboard computers are the most sophisticated and complex software programs ever developed for aerospace use. These programs, provided under contract to NASA's Johnson Space Centre, contain over 500,000 IBM-written instructions – 25 times larger than the IBM programs developed for the Saturn launch vehicle.

These primary computer programs are written so that they can be executed by a single computer or by all computers executing an identical program in the same time frame. This multicomputer mode is used for critical flight phases such as launch, ascent,

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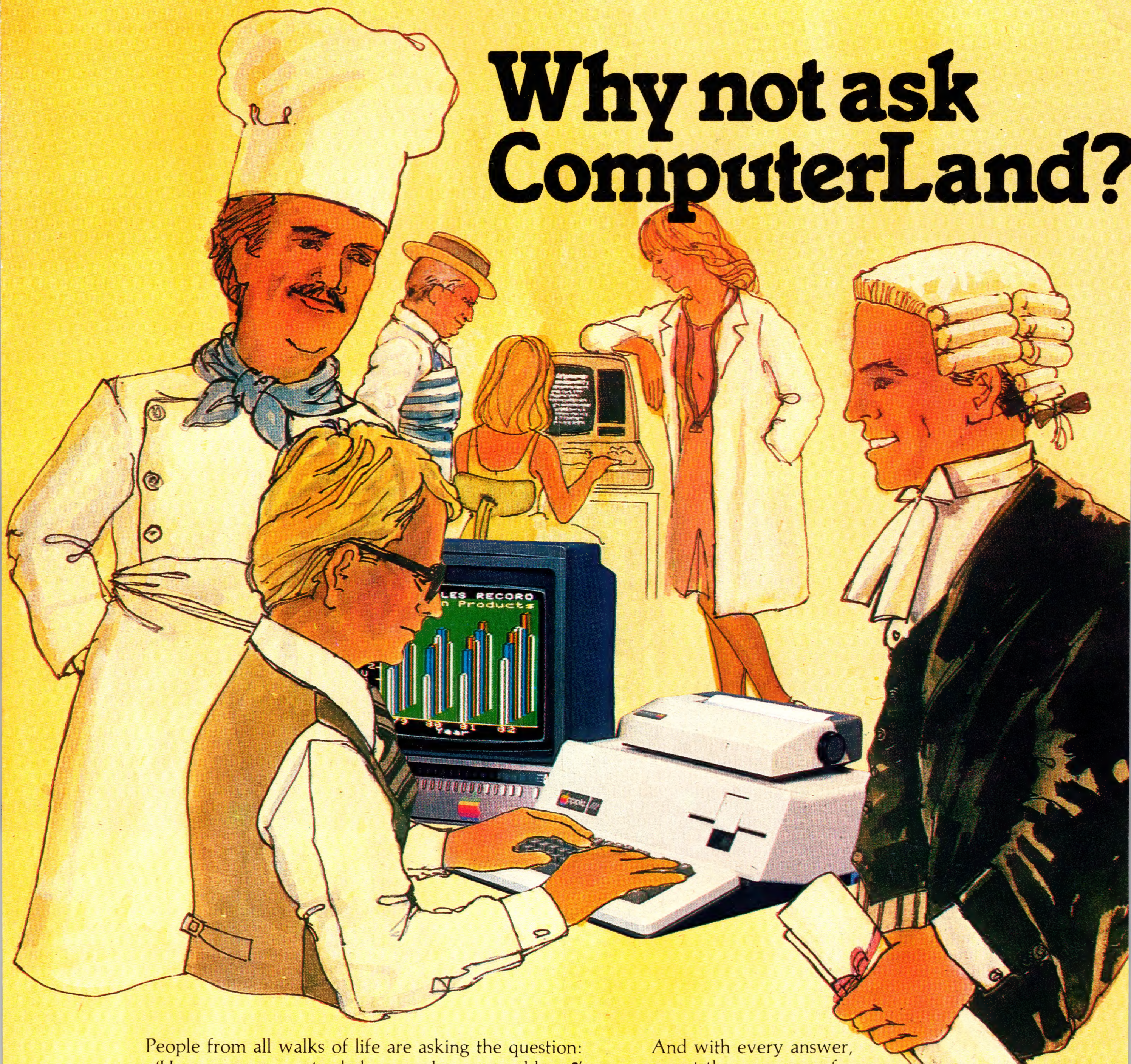

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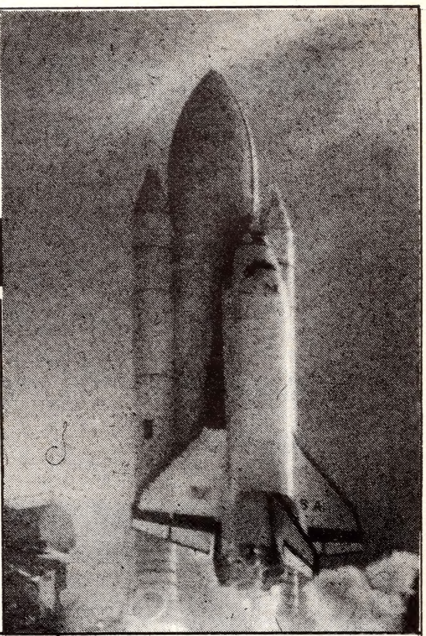

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COVER: COMPUTERS AND THE SHUTTLE

3 NEWSPRINT: The latest micro news, reported by Miriam Cosic.

7 COMPETITION: Your chance to win a printer and immortalise your name.

13 INSIDE PRINTERS: Peter Faff explains ust how printers work.

18 COMMUNICATION: Our readers write in.

19 COMPUTER GAMES: Another installment in David Levy's series.

23 COMPUTER ANSWERS: Your problems answered.

44 LEISURE LINES: J.J. Clessa poses more problems.

45 BENCHTEST: Neil Cryer tests the Bigboard.

53 PERSONAL OPINION: More random chat from Bob Pascoe.

55 GATEWAYS TO LOGIC: Derrick Daines continues his series on teaching microcomputing.

61 APC COMPILER: A tiny Basic compiler for the TRS-80.

71 ZX80 CORNER: Exclusively for the ZX80.

84 APPLE-CATIONS: Ian Webster writes for Apple Users.

86 OSI BASIC-IN-ROM: What's where by Earl D. Morris.

90 USER GROUP INDEX: An updated listing.

91 NEWCOMERS START HERE: Our quick intro for the microcomputing novice.

93 PROGRAMS: Our readers latest listings.

96 BLUDNERS: Our monthly confession.

100 ADVERTISERS INDEX:

Business Computer

25 WP BENCHTEST: Peter Rodwell reviews the Magic Wand.

32 PROFILE: Nigel Shepherd on Commodore.

35 PARLIAMENT HOUSE IN MICRO: The role of Cromemco in the building process.

38 MULTIUSER TEST: Sue Eisenbach and Chris Sadler review the MVT/Famos operating System.

Micro Computer

73 SOLAR SYSTEM SIMULATION: David Partyka looks at the universe with an Apple II.

79 DRAWING LINES ON PET'S 80 x 50 GRID: Harvey Davis shows how to use quarter-box graphics.

83 SINGLE KEY KEY DEVELOPMENT: Completing Peter Brooks' article on abbreviating commands.

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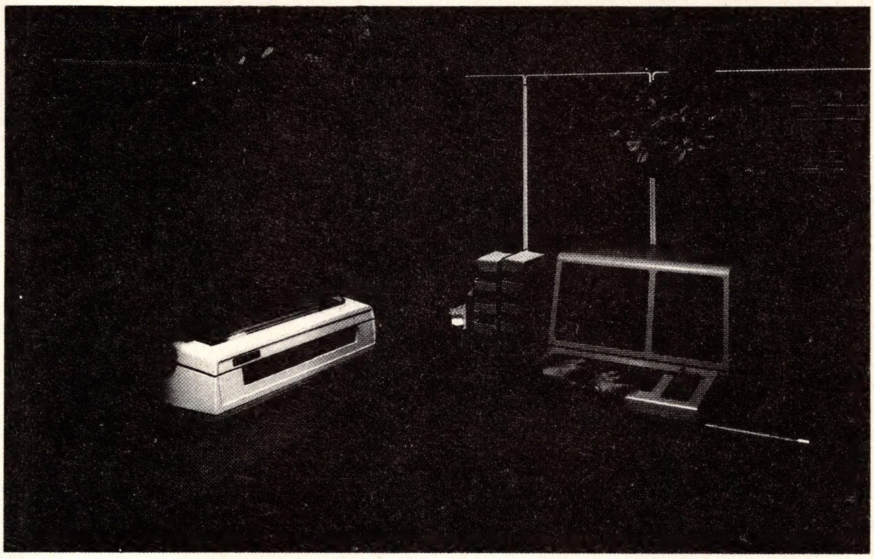

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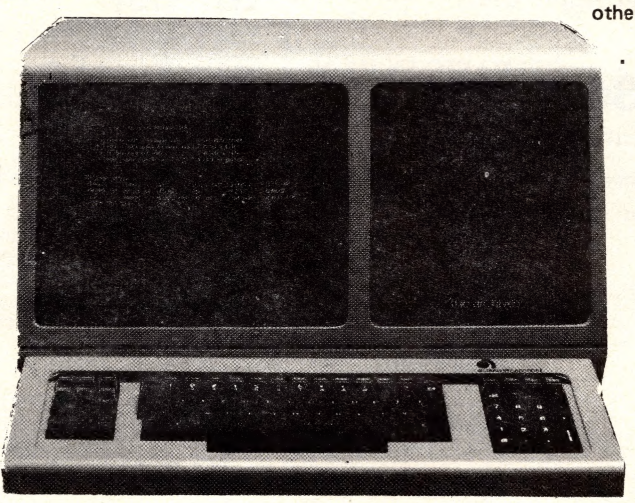

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DEALER ENQUIRIES INVITED

NEWSPRINT

Edible delicacies

Edible Electronics has released a ham program (for the computer gourmet?). It's a piece of software which converts a Commodore PET/CBM into an advanced amateur radio communications terminal. It has Baudot, Morse and ASCII send and receive operation, and slow-scan television keyboard transmission capability.

The program is written in 6502 machine code, which would make operation fast, and makes extensive use of the machine code subroutines resident in the machine's ROM. There is a received text area and a transmission buffer area with a status line dividing the two. More than fifty commands are recognized by the computer, giving a high degree of operating flexibility.

No interface is included, but details on interfacing are. However, if you have a Macrotronics unit you'll be pleased to know that the program will run on your computer, as is, using the Macrotronics interface.

Apparently programs are being developed which will allow programs to be listed and run over the air.

Joel Gotlib, chief cook and bottle washer at Edible, will also be selling the celebrated VIC from September. He's been expanding on some of the features. Plugging into any standard colour T.V. set, the unit has a full size keyboard with four user definable keys. It displays 22 characters by 23 lines, using ASCII characters and full PET graphics. There are eight background, sixteen foreground and eight character colours available. There's also a wide range of accessories to go with it.

Joel is at 50 Park St., Abbotsford, Victoria, 3068; Tel: (03) 41 5708.

Shops within shops

A new form of computer shop is opening in Sydney at the beginning of July. Situated in the lower ground level of Myer and run by Bernard Kirsner, it will initially be handling only Atari products. Running along the same lines as those used so successfully by Sears Roebuck and other department stores in the U.S., Myer are leasing a given amount of floor space to an outside business concern in return for a percentage of the gross sales.

The main advantage for the consumer is having expert product knowledge available within the convenient shopping environment of a department store.

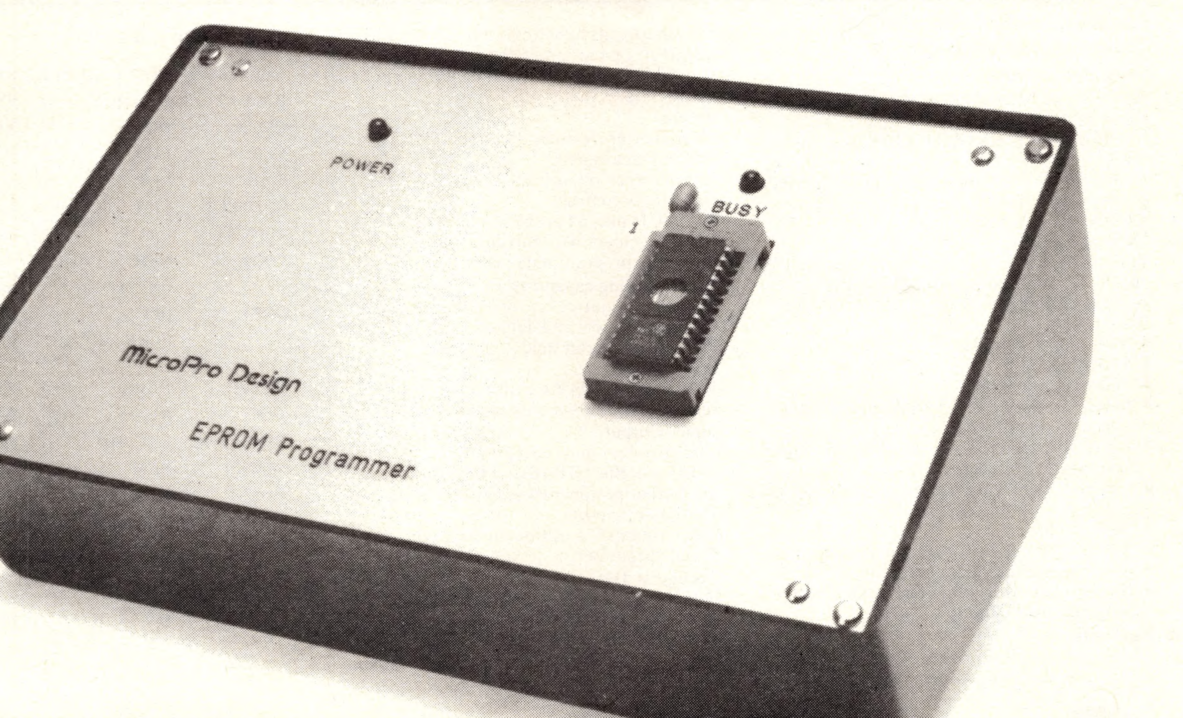
Megasize micro

CGF Electronics now has the Archives III, a micro with an inbuilt 5 Megabyte Winchester disk drive which, of course, begins to make the micro suitable for medium-sized businesses.

The machine contains a Z80 CPU, S100, the Winchester hard disk drive and a double-sided double density disk drive, a 12" green phosphor monitor and a detachable Honeywell keyboard.

The word processing software going along with it is the Wordstar; and most of the supporting software has been prepared by the local people, Integrity Management Services.

This model also has greater



This taciturn box is an EPROM Programmer, compatible with Commodore computers. The reason you can see no controls is that there are none – all functions are controlled by a program in the computer. The EPROM to be programmed is inserted into a socket on the port of the unit. The Control Program is normally provided in PROM for installation inside the computer, but is also available on floppy disk or cassette. Available from MicroPro Design, Suite 205, 6 Clarke St, Crows Nest, NSW 2060; Tel: (02) 438 1220.

In the world of personal computers there is just one that is known as the best: the PET

NOW 16K RAM AT 8K PRICE $999

The Commodore PET has become the standard for the Personal Computer Industry.

The Pet is completely integrated, with the processor, memory, keyboard and visual display unit contained within a robust housing, allowing easy transportation with no interconnecting cables necessary. In order to retrieve and save your data and programs, a storage device is used which operates like a cassette recorder, with your information recorded reliably on standard cassettes. The PET has 16k bytes of RAM. Optional equipment permits expansion to 32k. Also, it has 14k bytes of ROM.

The Pet communicates in BASIC—the easiest computer language. Easy to learn and easy to use, BASIC has now become the standard for personal computers, with literally thousands of programmes available. The PET is also programmable in machine language, allowing more efficient use of the system.

The full-size keyboard is capable of producing letters, numbers and graphic symbols. Upper and lower case is standard. Characters appear on the screen in a pleasant green colour designed to reduce eye fatigue and may be displayed in normal or reverse print.

PET's IEEE-488 Bus- just like H.P.'s mini and full size computers — permits direct connection to over 200 pieces of compatible equipment such as counters, timers, spectrum analysers, digital voltmeters and printer plotters from H.P., Philips, Fluke, Textronix and others.

The full range of Commodore Disk Drives and Printers are plug-compatible with the PET and a comprehensive range of cassette and disk based programmes are available through the extensive network of Commodore Dealers.

APPLICATIONS

The Commodore PET is a creature of many faces. Its applications are limited only by the user's imagination.

The future of the PET is virtually unlimited; its present capabilities are already many and impressive. As a personal computer, the PET can teach languages and mathematics; play games; create graphic designs; store meal recipes and change number of portions; maintain budgets, personal records and checkbooks; operate appliances and temperature controls.

As a management tool, it delivers the information the executive needs, in the form he can use, and available to him alone. Trend analyses charts and graphs can be almost instantly available.

The professional may use the PET for maintaining appointment schedules, recording income and expenditures and filing all the specialized information and forms he may need to make his work more efficient — from medical records for a doctor to income tax computations for an accountant.

The engineer, mathematician, physicist, has a tool far superior to the very best programmable calculators yet developed... at a cost that is comparable...and with almost infinitely greater versatility.

And the businessman has a computer that can maintain inventories, keep payroll records, operate accounts payable and receivables, issue cheques and handle correspondence.

Commodore PET 4016 Computer Technical Specifications.

Computer/Memory

Read/Write Memory (RAM) 16K bytes available to the user.

Read Only Memory (ROM) 14K bytes in total, divided into:
8K BASIC interpreter available immediately you turn on your PET,
5K Operating System
1K Test Routine

The 6502 micro-processor chip makes the PET one of the fastest and most flexible BASIC systems. Significant features of Commodore BASIC are:

- 960 simple variables
- 960 integers
- 960 string variables
- 960 multi-dimensional array fields for the above 3 types of variables
- Up to 80 characters per program line with several statements per line
- Upper/Lower case characters and graphics capability
- Built in clock
- 9-digit floating point binary arithmetic
- True random number generator
- Supports multiple languages; machine language accessibility

Keyboard

74-Key professional keyboard.
Separate calculator/numeric pad.
Upper-case alphabetical characters with shift key to give 64 graphics characters.
Can be set for lower case and shifted upper case characters.

Screen

40 characters wide by 25 lines (1000 characters in 8 × 8 dot matrix).
23 cm screen phosphor screen.
Brightness control.
64 ASCII plus 64 graphics characters.
Blinking cursor with full cursor control, including programmable control.

Screen editing capabilities

Full cursor control (up, down, left, right).
Character insert and delete.
Reverse character field.
Overstriking.
Return key sends the entire line to the CPU regardless of cursor position.

Input/Output

8 bit parallel input/output port.
IEEE-488 Bus (HP-IB and IEC Bus) allows up to 12 other peripherals to be connected.
Two cassette ports.
Video signals for additional displays.
Serial output port.

Technical Data

Dimensions: Height 355 mm (14″), Width 419 mm (16.5″), Depth 185 mm (18.5″), Shipping Weight 20.9 kg (46 lbs).
Power requirements 240V ± 10%, Frequency 50 Hz, Power 100 Watts.

Commodore BASIC

APPEND
BACKUP
CLOSE
CLR
CMD
COLLECT
CONCAT
CONT
COPY
DATA

DEF/FN
DIM
DIRECTORY
DLOAD
DOPEN
DSAVE
END

FOR/NEXT
GET

GOSUB..RETURN
IF..THEN
INPUT
INPUT #
LET
LIST
LOAD
NEW
ON..GOSUB
OPEN
POKE

PRWT
READ
RECORD
REM
RENAME
RESTORE
RUN

SAVE
SCRATCH

STOP
SYS
VERIFY
WAIT

SGN
INT
ABS
SQR
SIN
COS

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LOG
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AND
OR
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SPC
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ASC
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For details of your local dealer send to: Commodore Information Centre, Box 336, Artarmon, NSW 2064. Australia. Phone (02) 437 6296

Mlvl 469

This portable RS232C compatible recording system has a storage capacity of 72k characters and weighs only 12lbs. Made by Memodyne Corporation of Mass., US, the 234CV is a self-contained instrument which accepts and formats data, and records it back on certified digital cassettes. It has eight controls including Playback, off Load, Forward, Backspace and Step. It's being marketed in Australia by the Dindima Group P/L, P.O. Box 106, Vermont, Vic, 3133; Tel: (03) 873 4455; or P.O. Box 269, Elizabeth, S.A. 5712; Tel: (08) 51 2438.

expandability than the previous ones, with slots for graphics and communications.

CGF is on the 4th Floor, 520 Collins St, Melbourne, 3000; Tel: (03) 62 3382.

Delousing your heads

Most head cleaning diskette kits use a powder cleaner, which can have a pretty abrasive effect. 3M have a new kit which uses a liquid cleaner.

The point is to remove dirt and oxidation from diskette drive/write head in order to reduce data loss and job reruns caused by contamination. This product uses a cleaning solution applied to fabric which is put in the drive, then the drive is turned on. The rotating cleaning fabric alternatively wipes the heads with solution and dry surface. It takes about 30 seconds, and the diskettes can be used with single and double-sided drives.

Put an Antelope in your car

If you have room on the dash for any more gadgets, Zemco Inc., "the largest manufacturer in the world of after market trip computers for motor vehicles", has a new fuel management system. At the push of a button, you can read all kinds of status checks.

Using the instant fuel consumption readout of the "Fuel Manager", as it's called, you can learn the most fuel efficient driving techniques. It also helps save fuel because you can tell from a rise in fuel consumption that there's something wrong with your car. Presumably, you'll no longer have to rely on hearing the clunks, feeling the hiccoughs or noticing how much you hand over to the station attendant.

Available from Antelope Automotive Pty Ltd, 75 Military Rd, Neutral Bay, N.S.W. 2089; Tel: (02) 909 2155.

High tech music

One of the features of Music '81 is the International Conference of Music and Technology which Australia will be hosting in August. Composers and scientists from Europe, the U.S. and Asia will meet in Melbourne to discuss the future development of high technology and the effect it will have on the shape of music in the 21st century.

Australia is recognized as a leader in the development of music and technology. Techniques such as digital recording are bringing to the public's consciousness what is in fact the tip of the iceberg of the effect of computers on music.

The conference programme will include technical discussion sessions, formal concerts, special events and an exhibition of digital real-time synthsizers. For more information contact Linda Crawley on (03) 669 8520.

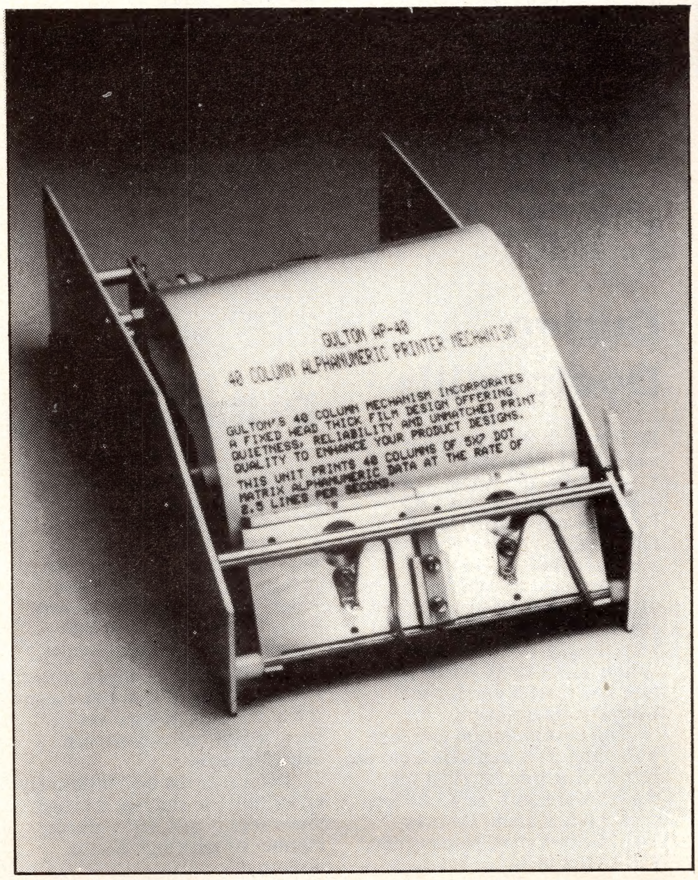
Computers gone troppo

In the gold-mining town of Charters Towers, in the far north of Queensland, advanced technology has become a cottage industry. Peter and Shona Hewitt, operating from their home, have established Computer Cottage – a company producing software for the Challenger.

Between them, they have both technical and business expertise; and they hope to supply homes and schools with well-documented, easy to use software. The idea is to offer a friendly and concerned service to their customers, in keeping with the cottage industry notion. Programs range from a school timetabler to their very own Adventure tape. They can be contacted through Box 455, Charters Towers, Qld, 4820.

Dick's doubler

Dick Smith Electronics has a new low cost adaptor unit for the System 80 and TRS-80 (Model 1). It's called the "Doubler" and allows single-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The AP-40 TM is a fixed head thermal printer mechanism designed for instrumentation output preferring text format. It has two fixed, dot matrix thermal printheads and a paper drive which feeds the paper under the printheads to exit in text format, first line at the top. The drive roll is the only moving part, providing the quiet, maintenance free operation typical of thermal printers. There are no electrics, and it interfaces with any micro-based system. From Tecnico Electronics: Sydney (02) 427 3444.

MICROPOWER offers such features as virtual memory and compressed data storage and yet is designed to compete, pricewise, with Tandy and Apple. The system uses bit-slice technology to outstrip the processing speed of "normal" micros, and the starter configuration consists of a single-user processor with 1 million characters of floppy disk storage. It can be upgraded to MCM's full POWER system, the multi-user distributed processor. From MCM Computers Ltd, Suite 600, 6700 Finch Ave West, Rexdale, Ontario, Canada, M9W 5P5, Tel: (416) 675 1353.

density disk systems to read, write and format using double density recording (a modified FM).

With conventional 35-track drives, double-density recording gives a formatted capacity of 175k, compared with the 87.5k with single-density recording. The system's ability to operate a single-density mode is retained, so compatibility is maintained with existing software data on single density disks. Recording mode is software selectable.

The Doubler plugs into the existing disk controller socket on the computers' expansion units; and comes complete with a comprehensive instruction manual and disk containing DBLDOS, a double density DOS compatible with TRSDOS, and various utilities.

Price is $225 from the Dick Smith store near you!

Moving words

CW Electronics of Brisbane has changed premises from their old location in Tarragindi to 416 Logan Rd (Pacific Hwy), Stones Corner – right next door to the port office. Brian Beamish, the managing director has said that the growth of the company has surprised even him at some stages.

The Microcomputer House has also moved – to Regent St, Chippendale. They are now handling *Cursor* Magazine, full of programs for the Commodore PET.

Double-multied

Cromix is a new operating system which allows full implementation of multi-user/multi-tasking in the Cromenco. Features include the ability to multiple task and have multiple users on hard file systems, password security system, time and date support and numerous file buffers for high speed disk intensive execution. Other features which aren't common of mainframes but are useful to all system users include the ability to reconfigure 1/0 user interface and to change commands.

It's based on the Bell Laboratories Unix system for mainframes, has extensive sub-system support with eight computer languages and offers application packages.

According to Norman Rosenbaum, of Informative Systems who are selling the thing, Cromix takes full advantage of the large amount of RAM and fast disk storage available. It uses 64k of RAM for the operating system, which allows the next six banks to be used to execute six concurrent tasks, or carry up to six users at a time. The system allocates memory only when it is required by a task. The flexible file system and generalised disk structure gives a disk address space greater than one gigabyte per volume, so file size is only limited by the available disk capacity.

Informative Systems Pty Ltd, is at 337 Moray St, Sth Melbourne, Vic. 3205; Tel: (03) 690 2284.

Curing Doctors ills

De Forest Software has released a medical billing package, C–AMP, for the Apple 2 or any other machine running UCSD Pascal. It was written locally by a fellow who is both a doctor and a programmer.

"Designed to calm the nerves of the medical receptionist and give total control of debtors", according to Deforest (sounds ominous), C–AMP is a total turn key system developed in a surgery environment.

Full customisation and software support is available from the author. The price is $950 for the software only, or $5,800 as a complete system. Deforest is at 26 Station St, Nunawading; Tel: (03) 878 9276.

A Sydney Source

Rumours flying around for the past couple of months have suggested that someone has plans to set up a consumer database in Sydney.

We've traced them to three fellows in Sydney who are planning to set up a Source-like database within the next three months. Although not as large as the Source, initial features will include user group information, electronic mail transfer, program exchange, news service, personal files, classified advertisements, entertainment guide, suggestion box and system bulletin.

It will start with four access lines and will be expanded as it picks up. A spokesman for the company, which is yet to be named, said that this is an initial plan of attack and subsequent stages will put more options on access. It will be open to anyone who pays the log-on fee and who has a system which will emulate a dumb terminal.

For OEM's and all

A recently arrived singleboard computer, the V-7II, is available from Multisource International. It is Z80 based, has a CP/M operating system, and includes CPU, 64k RAM, disk controller for up to four 5-megabyte floppy disks, three parallel ports and an RS232C serial port.

It's designed for OEM's wishing to build a small business computer. Contact head office at Suite 9, 65 Queens Rd, Melbourne, 3004; Tel: (03) 529 1284.

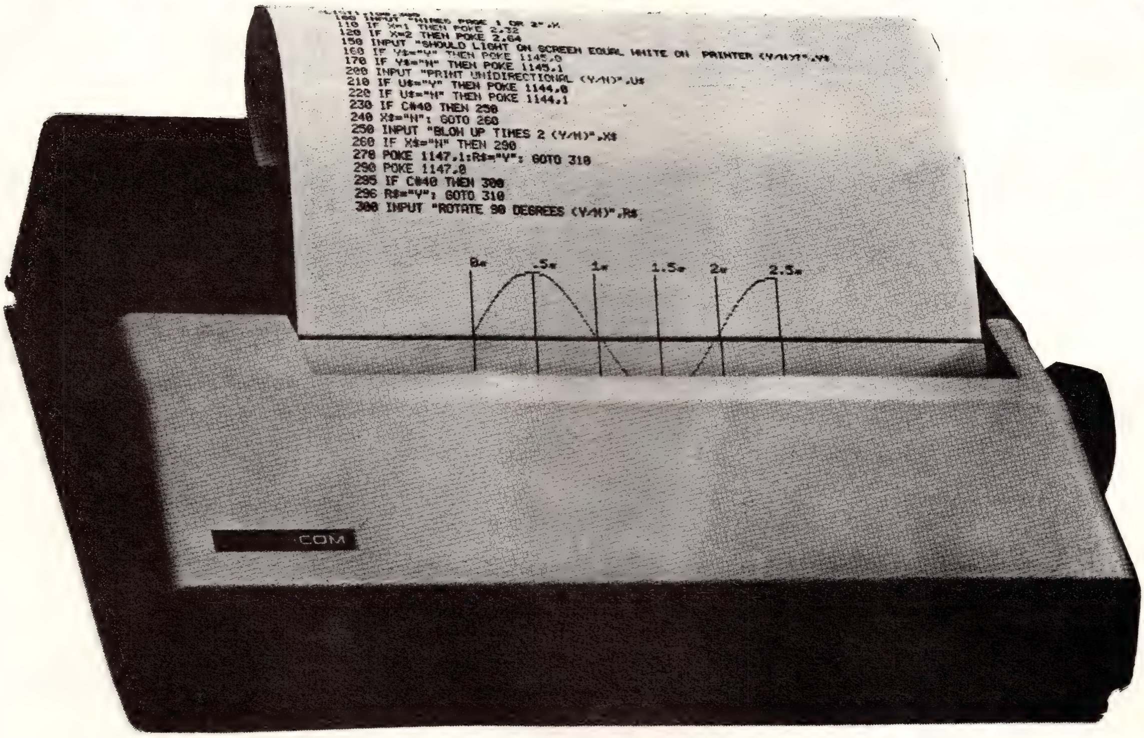
Delta dawning

The Apple distributorship wrangle appears to be all over bar the shouting, and Delta Semiconductor Peripherals has emerged as a second importer of the machines. An agreement between DSP and Apple's sole Asian distributors, Delta Communications has set off a rapid chain of events.

Agent-dealer arrangements have been signed in states except the N.T. Bruce Kehlet has been appointed as Northern Sales Manager.

Delta sees the deal ultimately benefiting the enduser through lower set-up cost and a greater number of sales and service outlets.

COMPETITION



```
100 INPUT "TIMES POKE 1 OR 2",X
110 IF X=1 THEN POKE 2,32
120 IF X=2 THEN POKE 2,64
150 INPUT "SHOULD LIGHT ON SCREEN EQUAL WHITE ON  PRINTER (Y/N)",Y$
160 IF Y$="Y" THEN POKE 1145,0
170 IF Y$="N" THEN POKE 1145,1
200 INPUT "PRINT UNIDIRECTIONAL (Y/N)",U$
210 IF U$="Y" THEN POKE 1144,0
220 IF U$="N" THEN POKE 1144,1
230 IF C#40 THEN 250
240 X$="N": GOTO 260
250 INPUT "BLOW UP TIMES 2 (Y/N)",X$
260 IF X$="N" THEN 290
270 POKE 1147,1:R$="Y": GOTO 310
290 POKE 1147,0
295 IF C#40 THEN 300
296 R$="Y": GOTO 310
300 INPUT "ROTATE 90 DEGREES (Y/N)",R$
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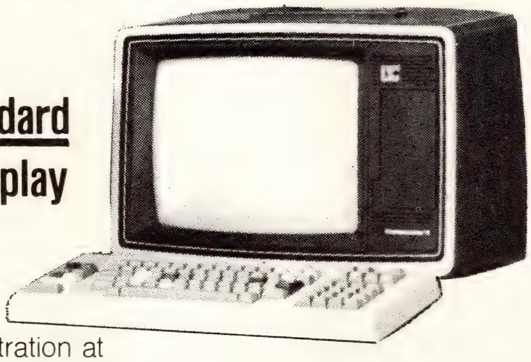

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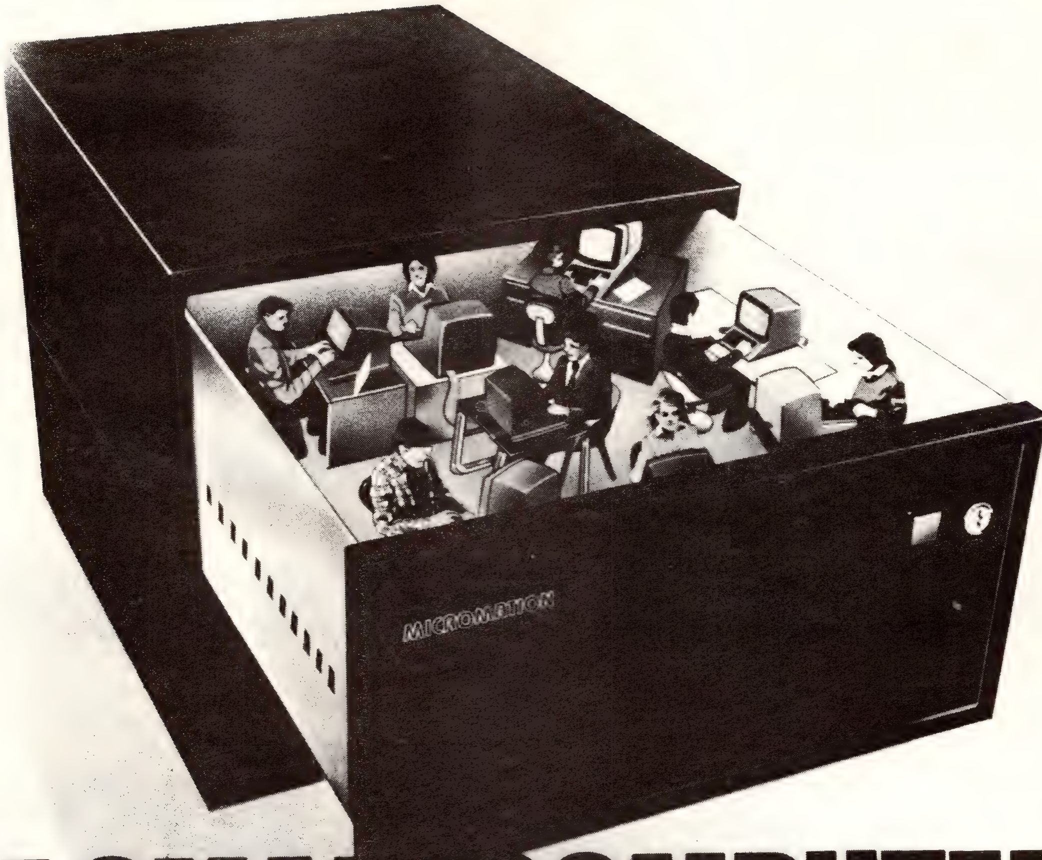

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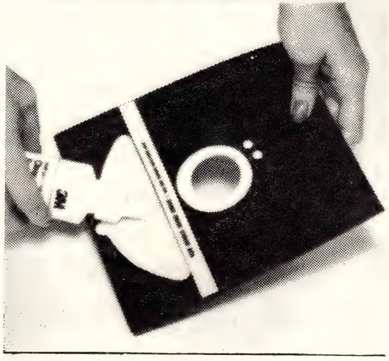

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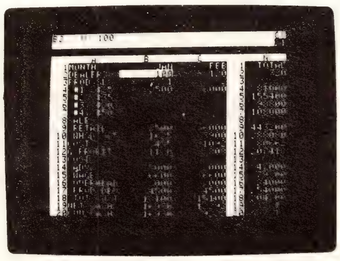

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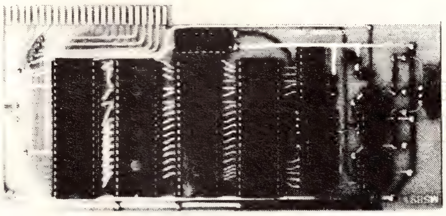

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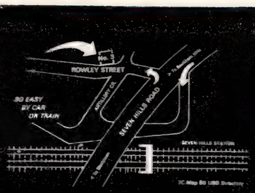

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INSIDE PRINTERS

Hard copy is an expensive luxury for most hobby computerists. With a little work, basic printer mechanisms can be interfaced to most micros. With this in mind, Peter Faff explains how printers work.

Over the past few years a great many ready-built matrix printers have found their way onto the open market. Many of these units give excellent performance and they generally come with an equally amazing price tag. Now, for an industrial user this is no problem since he can usually call it capital equipment and gain tax advantages from it, but the average computerist in the street is not so fortunate. It is with him in mind that I have written this article.

There are two basic printer technologies, which we will call 'digital' and matrix. The main difference between the two is that 'digital' printers use cast type in the form of wheels, drums, bands, daisywheels or golfballs, while matrix printers build up characters and symbols by using an array of dots. Unfortunately the print quality of a matrix printer leaves a lot to be desired when compared with, say, a daisywheel printer but for the average micro-nut who just wants a simple hard copy device this is no problem; anyway it must be difficult to plot high resolution graphs on a daisywheel printer. In this article I will concentrate on matrix printers since I am limited by space, although if sufficient interest is shown I may write a follow-up article that looks at cheap digital printers of the type that can be found living in any recent printing calculator.

There is a fairly large number of matrix printers available. These can be divided into three basic types on the basis of how the print is formed on the paper: thermal, electrosensitive and impact.

First, for those of you that have been living in the wilds for the past decade or so, I will give a basic explanation of how matrix printing works and I will also explain the various methods used to build up a line of printed characters. A matrix printer builds up a character or symbol in a rectangular array of cells by leaving some cells empty while printing a dot in others — this is shown in Figure 1. As can be seen, the various letters are built up of a matrix of 5 x 7 individual dots; by printing or not printing the various dots, a whole range of characters and symbols can easily be built up. The 5 x 7 matrix is about the minimum size that gives a legible character shape and vast improvements can be made by using a larger matrix cell, such as 7 x 12 or 12 x 16. These larger matrix sizes mean that the resultant characters are much more legible; they also make it easier to design characters such as 'p' or 'q' with a descender that falls below the line of print. In this article, I will concentrate on 5 x 7 matrix printers, since these are the types that commonly are available.

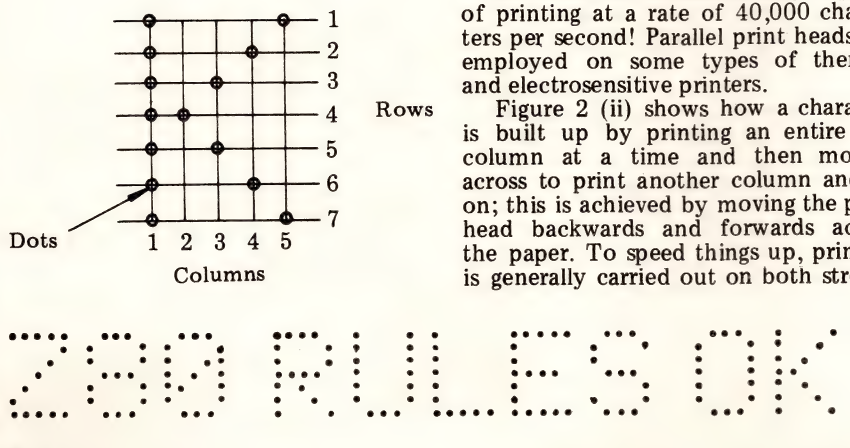

Fig 1

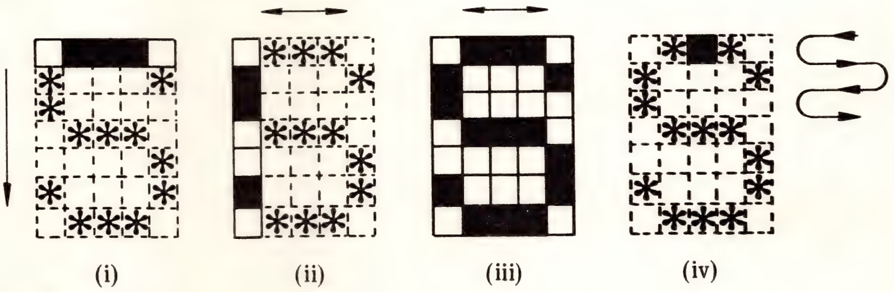

Fig 2

There are several ways that a matrix printer can print dots to form a character and Figure 2 illustrates the four most common methods.

Figure 2 (i) shows a parallel print head. This type of print head generally covers the entire width of the paper and has a separate print element for each individual dot. In use, this type of print head will print an entire line of character dot rows, the paper will then move up and another line of dots will be printed; this continues until the characters are built up. This type of print mechanism is generally very fast — and one unit is theoretically capable of printing at a rate of 40,000 characters per second! Parallel print heads are employed on some types of thermal and electrosensitive printers.

Figure 2 (ii) shows how a character is built up by printing an entire dot column at a time and then moving across to print another column and so on; this is achieved by moving the print head backwards and forwards across the paper. To speed things up, printing is generally carried out on both strokes of the print head. This method is used with all three types of matrix printers and it also crops up when driving dot matrix LED displays.

Figure 2 (iii) shows how a line of print is built up one character at a time, before stepping the print head over the paper to form the next character. In the case of a 5 x 7 matrix, the print head will have 35 individual dots but in practice the dots are connected as five rows and seven columns and the character is formed as in Figure 2 (ii). This is done to reduce the number of connections required from 36 to 12 but it does slow things down a little. A variation of this method uses a print head that looks like a standard seven-segment display but the segments emit heat instead of light, thus producing a format similar to a seven-segment LED display. This method of printing is used only with thermal printers.

Finally, Figure 2 (iv) shows how a character is built up one dot at a time. There is usually one dot mechanism per character or group of characters and again the dots are printed bidirectionally in order to speed printing up. This method is a variation of that used by a normal VDU and is used with several types of thermal and impact printers.

To complicate matters even further there are three different ways of making a visible impression on paper: thermal electrosensitive and impact. The first and probably the simplest method is thermal printing. This method uses paper that has a special heat-sensitive coat on one side which changes from white to blue when it is heated — the print heads therefore have to generate heat. To do this, small areas of a hard-wearing resistive compound are bonded to a ceramic substrate; these heating elements are interconnected by thin metal tracks. In some cases diodes are also bonded to the substrate and connected up to cut down problems when the elements are multiplexed. To heat an element it is necessary to pass a short pulse of current through it, thus printing a dot on the paper. The only noise that thermal printers make is generated by the paper feed mechanism and they are therefore suited to work in a quiet environment. The thermal elements are arranged in groups and the most common interconnection patterns are shown in Figure 3. Figure 3 (i) also gives a graphic representation of a thermal print element.

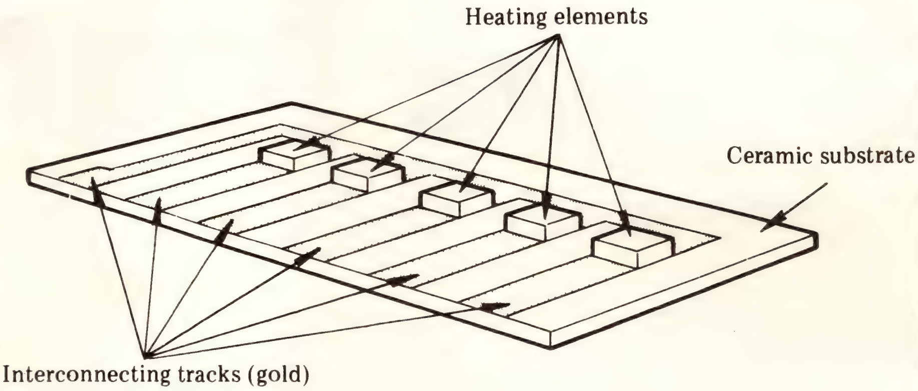

Fig 3 (i)

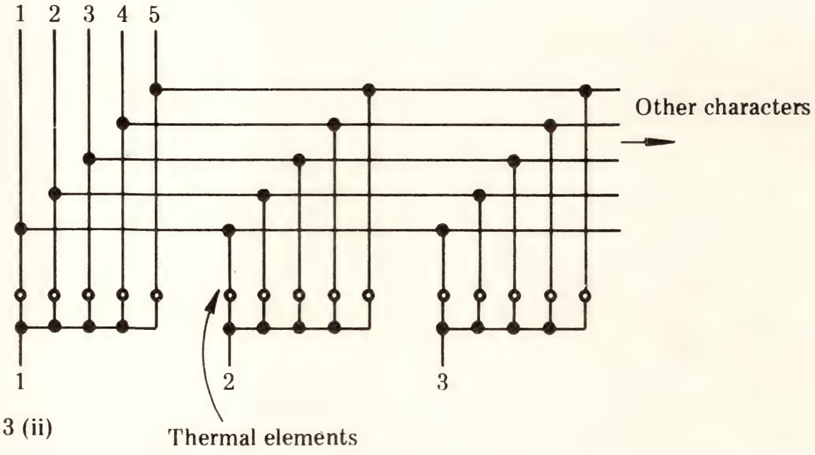

Fig 3 (ii)

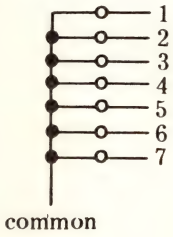

Fig 3 (iii)

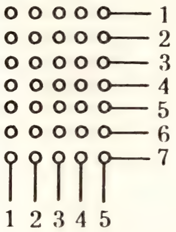

Fig 3 (iv)

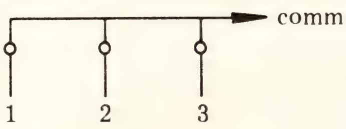

Fig 3 (v)

Figure 3 (ii) shows a parallel print head which can print an entire line of dots at one go. Some types have the heating elements arranged in groups of five while others that are intended for graphics use have the elements on a uniform pitch. The ceramic heads can usually be butted together to build up a longer line of print and common sizes have between ten and 20 character groups; as always the elements are multiplexed to cut down the number of connections required.

Figure 3 (iii) shows a serial head that builds up characters by printing an entire column of dots at one go. In use, the head moves across the paper and prints bidirectionally.

Figure 3 (iv) shows a serial print head that builds up a line of characters by printing one character at one go. To cut down the number of connections required, the elements are connected into rows and columns which are strobed during printing to energise the elements; this is faster than moving the print head across the paper to print each column.

Figure 3 (v) shows a serial-parallel print head that has one element per character or group of characters. In use the heads zig-zag down the paper to build up the characters in a similar fashion to a VDU, where, of course, only one dot is used. One readily-available printer of this type uses ten elements to print 20 characters and could possibly be picked up for nothing out of a dead calculator.

In its simplest form a thermal printer consists of a rubber roller that both drives the paper up and also provides a firm surface for the ceramic head to rest on. The paper passes between the roller and the head and is often driven by a stepper motor. A thermal printer with a parallel head is very simple mechanically and could probably be home-made; mechanisms that use serial print heads are much more complex and should be purchased as a ready-built unit. Also, a parallel thermal printer does not generate any timing signals and so the logic required to drive them is generally very simple when compared with a serial type. With a serial printer there is also more to go wrong but, provided that they are not abused, they will give years of trouble-free service.

The second category of matrix printers is the electro-sensitive type. These units are not for the faint-hearted and anyone brought up on good old 5 V TTL should skip the next few paragraphs since electro-sensitive printers require around 60 V to operate — so watch where you put your fingers. On the other hand, electro-sensitive printers are relatively foolproof and, during development, nothing short of a 20 lb hammer will cause much damage to the mechanism. As with thermal printers, electro-sensitive units require special paper which can be expensive. The output from an electro-sensitive printer is black on a silver background. The silver colour is provided by an extremely thin coating of aluminium deposited over a base of black paper and, in order to expose the black, it is necessary to melt a hole in the aluminium layer. If any of you have ever shorted your favourite screwdriver across a fully charged-up smoothing capacitor you will have a shrewd idea of how this is achieved. By grounding the bulk of the paper roll and putting a high voltage on selected print electrodes a hole is melted in the metal layer, thus exposing the black backing; see Figure 4 (i) and (ii).

As with thermal printers there are several ways in which an electro-sensitive printer can build up characters and the two most common ways are also illustrated in Figure 4.

Figure 4 (iii) shows a serial print head where a vertical array of seven electrodes is moved backwards and forwards across the paper printing characters one column at a time. When a full line is printed the paper spaces up for the next line and the print head reverses direction. This method is reasonably fast but it does call for some exotic mechanics to control the movement of the print head and paper feed; these printers also generate several timing signals which must be taken into account when driving the thing. The timing signals ensure that everything prints in the right place.

Figure 4 (iv) shows a parallel print head which has a line of electrodes stretching across the paper. This head prints one dot line at a time and can easily be used to plot graphs, etc. The mechanism I will describe consists of a fixed electrode head, a motor and a drive roller. No timing signals are generated and the unit is very easy to use, since the group of 100 electrodes is reduced to ten groups of ten by a multiplexed drive circuit incorporated into the printer itself. This unit can also be found in dead calculators.

Finally the third category of matrix printers is the impact type. As the name implies, these use a mechanical impact to print on plain paper using a ribbon; they can also produce copies when used with pressure-sensitive paper. Since impact printers use plain paper they are much cheaper to feed than either of the other types and this may be an important consideration if you intend to do a lot of printing. Apart from the noise, impact printers are very good.

The dots are usually printed by a hardened needle that hits the paper at a rate of knots; the paper is supported by a solid backing roller. There are several ways to accelerate the needles and common methods include a solenoid pulling a plunger, magnetic plungers with spring assistance and a lever rotating cam system; all give similar results. As with thermal and electro-

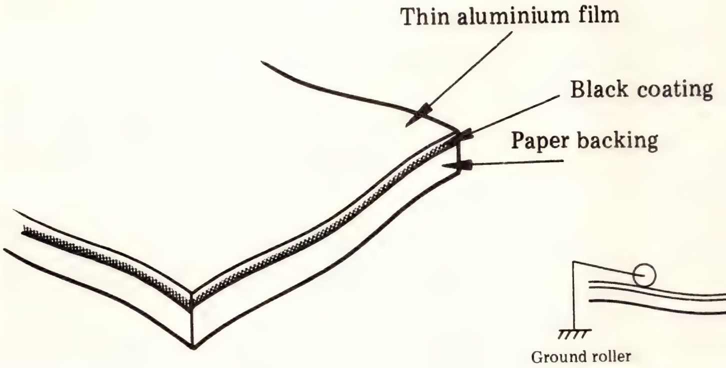

Fig 4 (i)

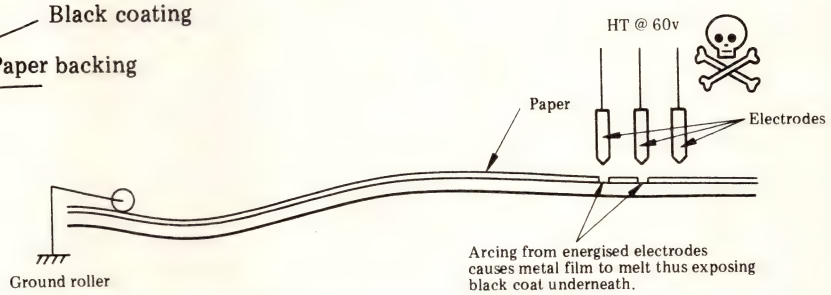
HT @ 60v
Paper
Electrodes
Ground roller
Arcing from energised electrodes causes metal film to melt thus exposing black coat underneath.

Fig 4 (ii)

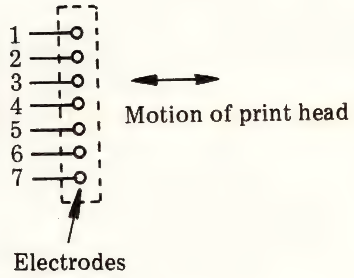

Fig 4 (iii)

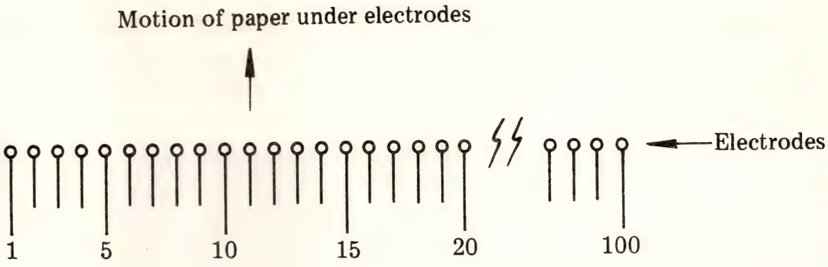

Fig 4 (iv)

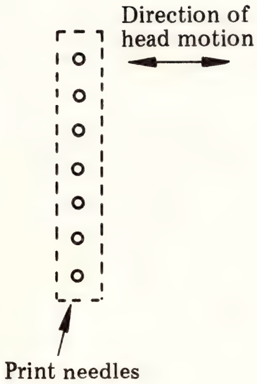

Fig 5 (i)

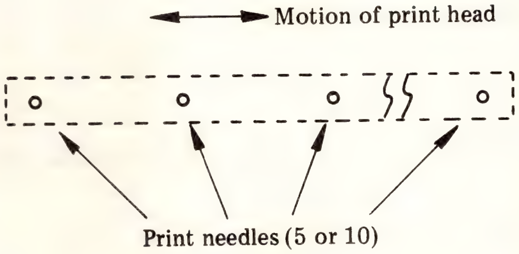

Fig 5 (ii)

sensitive printers, there are several configurations of print needles that are used and two of the most common are illustrated in Figure 5.

Figure 5 (i) shows a serial print head that moves across the paper and prints characters one dot column at a time. This is the most common method used by impact printers.

Secondly, in Figure 5 (ii), we have a serial parallel print head which uses one needle to build up a group of several characters one dot at a time; the print head moves backwards and forwards across the paper. Both types of impact printers generate a variety of timing although this can be reduced to a minimum by letting your micro do all the hard bits.

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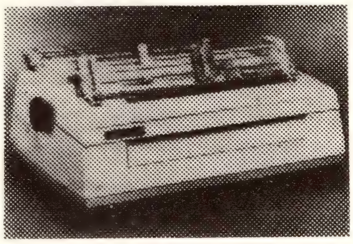

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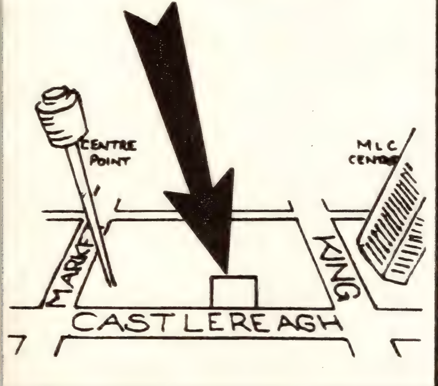

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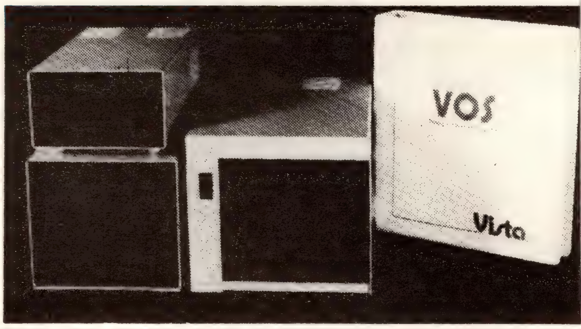

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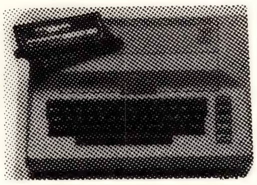

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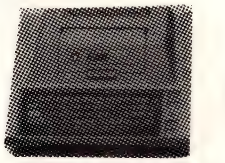

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lour: 16 colours, each with 8 intensities.
und: Four independent sound synthesizers (in addition to dio through TV) for musical tones or game sounds. Four aves. Variable volume and tone. Internal speaker.
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nguage: ATARI BASIC cartridge is included.
splay: Highest graphics resolution 320 x 192. 24 lines of characters. Three text modes.

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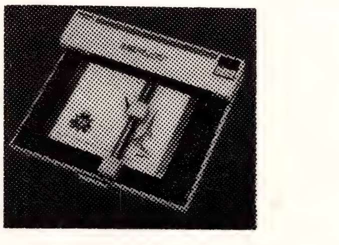

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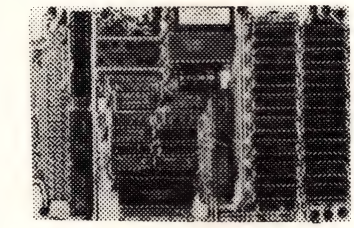

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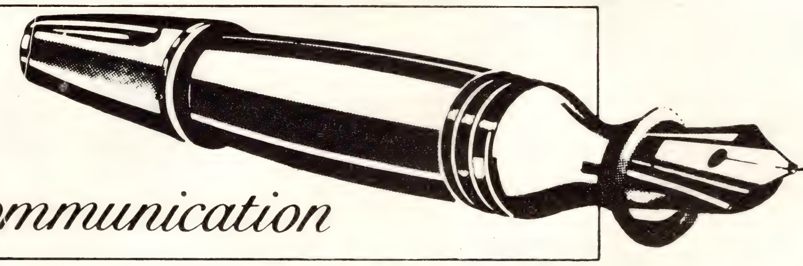

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Easier entry

As a half-blind, one-fingered keyboard poker, I have found that the easiest way of entering a long program single-handed from written matter is to dictate it first onto tape on an ordinary tape recorder; then using headphones, type it in at a rate appropriate to one's ability. This way leads to far fewer errors (spaces for example, can be counted aloud both on dictating and on playing back), far less fatigue and is much quicker. In addition the listing can be much more easily checked (again via the headphones) and it seems to allow much earlier understanding of the program.

The method is so successful that I am considering modifications to my PET to allow the built-in cassette to be used for the job.

Peter Tyler.

When does 4 not equal 4?

I have owned a Challenger C4P for nearly a year now and have had much pleasure discovering all the tricks the user's manual does not explain. After reading widely and delving deeply into the various anomalies that reside in the ROM chips, provided by Microsoft, I thought I had found all the answers. Then one day I received my monthly copy of APC, and turning to Leisure Lines I found a puzzle that involved perfect squares.

The puzzle caught my fancy and sent me scurrying to my computer. All I had to do was to find three numbers separated by five, and all perfect squares. Two numbers came immediately to mind. Nine and four are perfect squares and are five apart – but then neither -1 nor 14 are perfect squares, so that counted out that combination.

It soon became obvious that the required numbers would be decimal fractions. Now all I had to do was start the computer running, find lots of perfect squares and compare them to each other to see if they were five apart.

The program came out like this:

```
10     DIM B(500)
20     B=X:B(X)-BA2:X=X+1
30     FOR Y=0TOX
40     IF B(Y)/100=B(X)/100
50     NEXT:GOTO20
RUN
```

Wait patiently. Any minute now I will see 20 30 appear on the screen. This is my check and will indicate that 400/100 = 900/100 - 5; or 4 = 4, a fairly well-known fact.

Nothing yet. Put the cats out. Television's finished; turn it off. Still nothing.

```
CTRL    C
PRINT   X
250
OK
```

No, it's not OK.

```
LIST
```

Look carefully through the program. No obvious errors.

```
PRINT B(30): B(20)
900    400
```

That looks good. The time has come to interrogate the machine.

```
IF B(30)/100 = B(20)/100 +5
        THEN PRINT "OK"
```

No answer from that one.

The hour is late and there is obviously something seriously wrong with the computer.

After spending a restless night, and a day spent puzzling over why 4 didn't equal 4 any more, evening finally arrived.

Back to the keyboard.

```
BREAK. C. RETURN. RETURN.
        RETURN.
B(30) = 900:B(20) = 400
IF B(30)/100 = B(20)/100 +5
        THEN PRINT "OK"
```

OK. Hooray! 4 once again equals 4. Put in program and run.

Nothing.

Go through B(20)/100, etc., again.

Nothing.

Once more 4 doesn't equal 4. Why? What have I done? A blinding flash! SHIFT N. I used SHIFT N to get my squares. What effect does this have on a number?

```
A=10↑2 : PRINT A - 100
```

Surprise! The answer was *not* zero.

The SHIFT N on the Challenger adds a little bit (1.7355E-05) extra to the number - but not where it will be printed on the screen. This is alright for most calculations, but not for an IF - THEN comparison.

The solution?

```
20 B = X : B(X) = B*B : X=X+1
```

The answer to the puzzle? I am still working on it.

John Vagg,

PET POKEs

Many of your readers will be acquainted with the Commodore PET 'Space Invaders' program and many of them are probably left-handed. I myself am one of these unfortunates; I too wish that the controls of the program were the same way round as the real thing.

I have disassembled the program and can reveal that the appropriate modifications are as follows:

```
POKE 1428,252
POKE 1430,253
POKE 1442,254
POKE 1938,8
POKE 5434,65
POKE 5462,68
POKE 5491,74
POKE 5945,253
POKE 5953,254
POKE 5964,247
```

These modifications only apply to the NEW ROM version of the program though I suspect that they may work on the OLD ROM program as well. The new controls can be read in the instructions; they are A-Left, D-Right and J-Fire.

Anyone who knows how to record the corrected version onto a tape (for the sake of Commodore's profits I won't relate the method, but it is in the PET manual) might just as well correct the spelling mistake on the first screen by POKE 7736,15.

To make the changes, load the program using the LOAD command, type the POKE instructions and then type RUN. The whole program will then function as per normal, only the commands have been changed.

William Roberts.

Another last one

Reading David Tebbutt's article on 'The Last One' gave me a strong case of *deja vu.* It took me back to 1956 and machine coding, when the eraser was as much the programmer's tool as the pencil and all IBM had to sell was an inefficient machine for which you had to 'optimum program' (when the drum came round).

Cobol was to do away with programmers. All you had to do was fill in a form and then define the problem.

Plus ca change, plus c'est la meme chose.

Fred Musk.

If you pause to think, the constraints in any attempt to computerise are the environment, the data and the problem. However English-like programming becomes, it will still be necessary to define these. You miss the point Mr Musk – it's a question of level – Ed.

Anti-List

While writing a program for a small local firm I was asked to write a program which couldn't be listed – only RUN. At the time I was using an Ohio Superboard and I found that an amendment to the pointers used by the LIST routine did the trick. The first line points to the address of the next line and so on. So, by zeroising this first pointer, only line one will be listed. The program will still work since these pointers are not used when the program is run.

As the lowest line number on a Superboard is 0, I suggest that you put a REM statement in at this position. A POKE 769,0 will zeroise the pointer, while POKE 769,7 will restore it.

Users of other machines should be able to use this method – it's simply a case of finding out where programs are stored in memory and studying the first few bytes for the pointer.

B. Mistry.

Those with PETs may get some useful tips from the 'Get Well Soon' article in APC March, 1981 – Ed.

COMPUTER GAMES

David Levy continues his historical survey of the most important milestones in mainframe chess programming.

The first program of the modern generation was written at MIT by Richard Greenblatt, a student, and two colleagues. Work on the program began in November 1966 and by April the following year it had scored two wins, two draws and no losses in a tournament with human players. Based on statistics given in Greenblatt's paper, I would estimate that his program, at that time, was stronger than any commercially available chess machine currently on the market. The name of his program was MacHack VI.

MacHack employed a plausible move generator containing some 50 heuristics. The program was intelligent enough to know that certain heuristics were not always applicable, but depended on the nature of the position. In this way, moves selected by the plausible move generator were not always exactly the same set of moves as those which would have been chosen by a linear evaluation function. From this aspect of MacHack's decision process the microprogrammer can learn an important trick — it is often useful to use one evaluation mechanism (or set of heuristics) to select the plausible moves for the tree, and another one for performing the evaluation of terminal nodes.

The plausible move generator made its decisions by considering the moves themselves, rather than the positions arising after the moves were made. For example, if a move is bad because it blocks the line of attack of another of the player's pieces, the program would recognize the fact rather than look at the resulting position and say to itself "Hey! This position is bad because my bishop is blocked." By accepting or rejecting moves for the plausible move list in this way, the program saved a great amount of computation.

During the plausible move computation, each square of the chess board was assigned a measure of importance, corresponding roughly to the estimated value of having an extra piece attacking that square, or the cost of moving away a piece which currently attacked that square. The most important criteria used for assigning these values included how near the square was to the centre of the board or to the enemy king, and whether or not the square was occupied by one of the program's pieces under serious threat.

The value of a piece in strategic terms (as opposed to its actual material value) was related to the number of squares it attacked ie its mobility, and to the number of enemy pieces that it attacked. These strategic values were computed for the piece in its old and new locations and a strategic gain was taken as an indication that the move should be on the plausible move list. In other words, if a move appears to put a piece on a better square, that move is worth further examination.

The program encouraged certain types of attack on squares that were considered possible weak points, for example weak pawns, pinned pieces, and pieces defending other pieces. Moves which fell into these categories were also added to the plausible move list.

MacHack performed an alpha-beta search, with forward pruning. The plausible move generator would select a number of moves at each level of lookahead, and add to this number any moves which satisfied certain conditions: all safe checks were examined; at the first and second plies all captures were investigated; the moves of a certain number of distinct pieces are examined, so that the program would not ignore most of the board if all of the moves of a single piece were highly plausible. The minimum number of moves selected by the plausible move generator was normally six at each level of lookahead, but in tournament mode, ie when playing at a rate of 2-3 minutes per move, the program would examine a minimum of 15 moves at the first two ply, nine moves at the next two ply, and seven moves at each subsequent level. Only when the minimum number did not exist (for example when one side was in check or had only its king on the board) would the search be narrower, though of course the alpha-beta algorithm would often prune away branches on which there were plausible moves.

One of the few advantages that mainframe programmers have over those writing for a micro, is the availability of enormous backing store. This enables a program to employ transposition tables, which are advantageous in preventing the program from evaluating the same position more than once. In chess, as in many other games, it is frequently possible to reach the same position by different routes, and we call this phenomenon transposition. As a simple example, if White makes move A, Black makes move B, and White then makes move C, we shall reach the same position as if White had made his moves A and C in the reverse order. MacHack produced a hash value for every position evaluated in the tree search, and together with this value the program stored the score for the position and a note of the depth of search at which the evaluation took place. If the position is created again during the search, the program would not recompute the score for the position but would take it from the value scored together with the hash for that position. Even though MacHack stored only 32,000 positions in hashed form, it was able to save considerable computation time and as a side benefit, it was quickly able to detect draws by repetition.

The MacHack program represents the first really significant milestone after Shannon's paper because it was the first program to make good use of the Shannon-B strategy. The strength of the program in 1967 was extremely impressive and created considerable publicity for computer chess among the computing and chess fraternities. This publicity served as the impetus for many of the groups which started programming around 1967 or 68, for example the Slate/Atkin/Gorlen group at Northwestern University and Newborn at Columbia University. In fact Greenblatt and his colleagues probably did as much for computer chess in 1967 as Shannon had done almost 20 years earlier.

I should like to offer you two examples of the playing strength of the Greenblatt program. The first is a position which was shown to several

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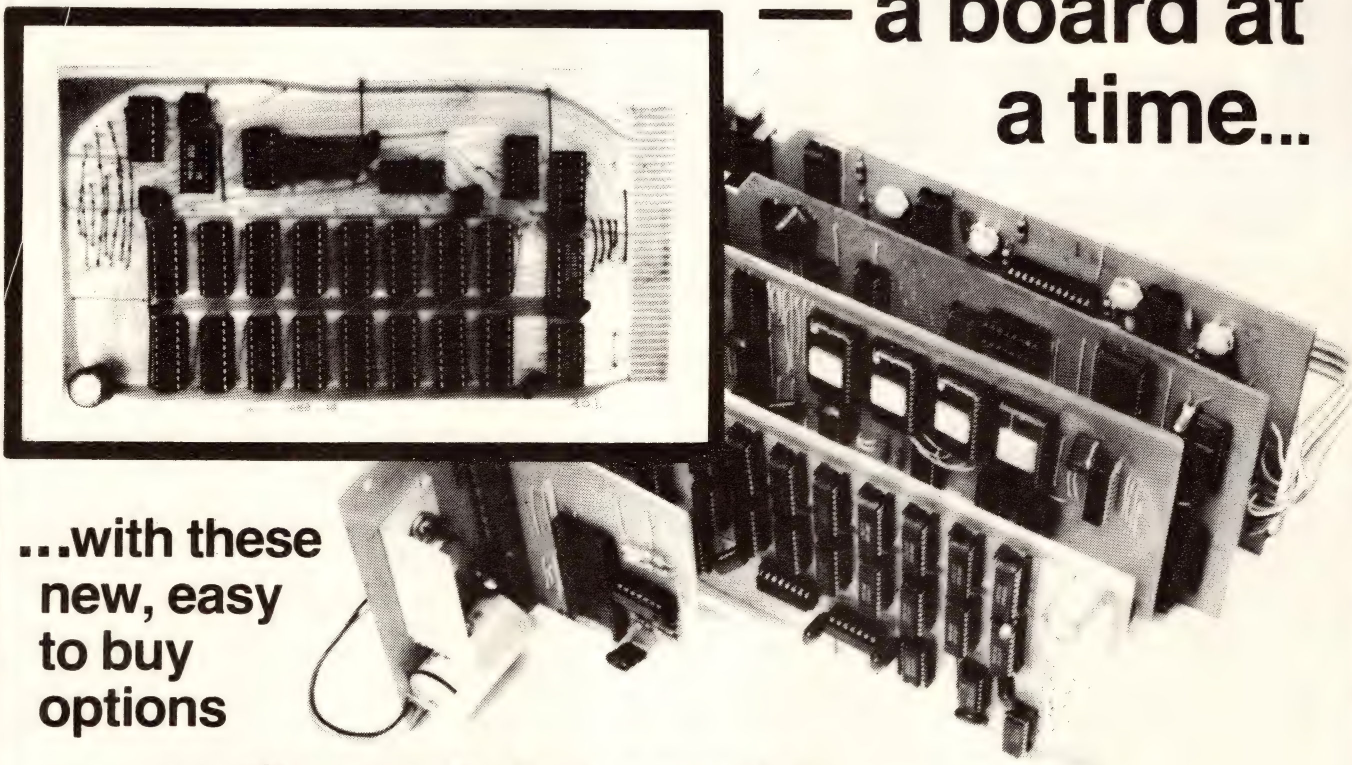

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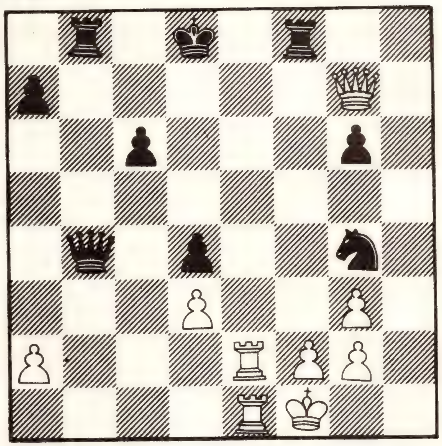
strong American chess players, including Masters, and defeated a number of them.



Black to play

This position is a win for Black, who has an extra knight for a pawn. But the task is to find a quick win. If White is allowed to survive he might conjure up counterplay based on the exposed position of the black king and the weakness of Black's pawns on g6 and a7. How can Black force a quick win?

MacHack discovered the correct continuation:

1 . . . f8-f2+

For the program to play this move it must have been able to see 9-ply ahead, in the crucial variations.

2 f1-g1

The alternative was 2 e2-f2 g4-h2+ 3 f1-e2 (or 3 f1-g1 b4-e1+ 4 g1-h2 e1-f2, when Black is a rook ahead) 3 . . . b4-b2+ 4 e2-d1 b2-b1+ 5 d1-e2 b8-b2 mate.

1 . . . f2-e2
3 g7-h8+ d8-c7
4 h8-f6 e2-e1+
5 Resigns

To show that a computer program is a good chess player, it is not enough to give an example of its tactical prowess. The very best programs are extremely adept at tactical combinations but are often let down by their poor strategic understanding. So the proof of the whole pudding must lie in an examination of complete games. The following is the first game ever won by a computer program in a chess tournament. Its opponent was rated 1510 on the USA rating scale, equivalent to a weak club player. The game was played in the Massachusetts State Championship, 1967.

WHITE: MacHack VI
BLACK: Human
1 e2-e4 c7-c5
2 d2-d4 c5-d4
3 d1-d4

MacHack knew no openings at that time and plays very much as many of today's commercially available machines. This type of opening is bad for White because it allows Black to bring out his pieces 'free of charge', by using developing moves to harass the white queen.

3 . . . b8-c6
4 d4-d3 g8-f6
5 b1-c3 g7-g6
6 g1-f3 d7-d6
7 c1-f4 e7-e5

A dubious decision. The human was obviously worried about the possible advance of the white pawn from e4 to e5, but Black should have continued 7 . . .f8-g7, and if e4-e5, then f6-h5, attacking White's bishop.

8 f4-g3 a7-a6
9 e1-c1 b7-b5
10 a2-a4 f8-h6+ ?

An ineffective move that weakens an important central pawn. One gets the impression that the human felt he could take risks against MacHack.

11 c1-b1 b5-b4
12 d3-d6

Black, when making his tenth move, almost certainly overlooked the fact that on the d6 square, White's queen or rook will fork the two black knights on f6 and c6, thereby rendering harmless Black's threat to the white knight on c3.

12 . . . c8-d7
13 g3-h4 h6-g7
14 c3-d5 f6-e4
15 d5-c7+

Black may have overlooked this response, but in any event his position was hopeless.

15 . . . d8-c7
16 d6-c7 e4-c5
17 c7-d6 g7-f8
18 d6-d5 a8-c8
19 f3-e5 d7-e6
20 d5-c6+

MacHack spots a simple queen sacrifice that forces mate.

20 . . . c8-c6
21 d1-d8 mate

A benchmark chess program

It is perhaps worth mentioning in passing the work performed by Jim Gillogly during the early 1970s on a program designed as a benchmark for other chess programs. Gillogly's program, which he named TECH, had a very simple program structure which could easily be emulated by anyone using a micro. Rather than perform strategic evaluation on all terminal nodes in the tree, the TECH program only took a close look at the nodes at the first level of look-ahead. It evaluated all these positions, sorted them into order and only changed this order if a full-width search revealed the forced win or loss of material for a root move. Programs with such a structure can play perfectly recognisable chess and are tactically quite satisfactory but they are hindered in their overall playing performance by a lack of strategic depth.

Those of you wishing to start writing chess programs for your own machines could do a lot worse than employ Gillogly's approach. Because strategic evaluation is only carried out on the (say) 30-40 root moves, the program can perform quick full-width search, using the alpha-beta algorithm, to detect forcing variations that affect the material status of the board. Such a program is relatively easy to write and should perform at roughly the same level as a Chess Challenger, provided that your strategic evaluation function is well thought out.

Gillogly argued that to be of any real merit, a chess program must be able to play better than a TECH type program, given the same amount of time, because the TECH program did not do anything clever. A really good programmer could probably write a TECH type program in little more than 2k of code (assembler) and I would not be surprised to see a program of that size playing better chess than some of the 8k and 16k cassette programs available to personal computer users today.

Deep or shallow search

Not entirely unconnected with the previous section is the question of how essential it is to search the game tree as deeply as possible. There are two distinct schools of thought on the subject: programmers usually prefer to search as deeply as possible, on the grounds that they are more likely to notice neat tactical possibilities; but a minority believe that shallow search, with more attention being devoted to each node, can lead to equally good play. Since human chess players look at a very small tree, this second approach is clearly endowed with some merit, but most chess programmers prefer the exhaustive search technique, possibly because of a lack of confidence in their own ability to create an advanced evaluation function that would be sufficiently sophisticated to perform drastic forward pruning.

Up to now almost all of the world's strongest programs have been the 'brute force' type — searching enormous trees but performing relatively little sophisticated evaluation at the terminal nodes. The TECH program is possibly the supreme example of this genre, performing only a material evaluation at the terminal nodes. We do not yet have sufficient experience with intelligent chess programs to be able to determine which approach is superior but I hope that the following game, despite exhibiting rather passive play by Black, will convince the reader that brute force is not the only possible route to a master strength chess program. For those programming chess on a micro, the intelligent approach offers much scope for original research and I would like to hear from readers who have any interesting or fresh ideas on this subject.

This game was played in a computer tournament in Dortmund in 1975.

WHITE: Schach MV 5.6
BLACK: Fischer/Schneider
1 b1-c3 d7-d5
2 d2-d4 c8-g4
3 f2-f3 g4-f5
4 e2-e4 d5-e4
5 f3-e4 f5-d7
6 g1-f3 b8-c6
7 e4-e5 e7-e6
8 c1-g5 f8-e7
9 d1-d2 g7-g6
10 f1-d3

So far Black has played rather passively, but White has developed its pieces on sensible squares. White's latest move is, in fact, a mistake, which should lose a pawn to 10 . . . c6-d4 11 g5-e7 d4-f3+ 12 g2-f3 g8-e7, but Black was unable to see this far.

10 . . . b7-b6
11 g5-e7 g8-e7
12 e1-c1 e8-g8
13 d2-h6!

Immediately beginning an attack against the black king. The threat is f3-g5, followed by h6-h7 mate.

13 . . . e7-f5
14 d3-f5 g6-f5
15 f3-g5 d8-g5+

Giving up the queen was the only way to prevent mate. If 15 . . . f8-e8

16 h6-h7+ g8-f8 17 h7-f7 mate.
16 h6-g5+ g8-h8
17 g2-g4

A fine move, opening up other lines of attack to the black king.

17 . . .   f5-g4
18 g5-g4   f7-f5
19 g4-h4   f5-f4
20 c3-e4

Here comes the other knight.

20 . . .   f4-f3
21 e4-g5   f8-f7

Again the only way to prevent mate on h7.

22 g5-f7+ h8-g8
23 h4-f6   f3-f2
24 f7-h6 mate

It would be reasonable to deduce, having played over this game, that the program playing the white pieces had a very good idea of what it was doing; that it planned a king-side attack from early on and then executed this attack in a well planned manner. In fact, White did not employ any look-ahead whatsoever. All of its moves were found as a result of a one-ply search. Its king attack feature was obviously well designed but there was no tree search — the planning was all implicit in the evaluation function This should provide some idea of just how much *can* be achieved without a deep look-ahead and I hope it will encourage some of you to write intelligent programs rather than programs which perform brute force searches of large trees.

The northwestern program

To conclude this survey I shall give a brief description of the famous program, witten at Northwestern University, by David Slate, Larry Atkin and (in the beginning) Keith Gorlen. This program has won most of the important computer chess tournaments of the 1970s, and the interested reader would do well to read a more detailed account of this program, which may be found in Peter Frey's outstanding book *Chess Skill in Man and Machine*.

The Northwestern University program, whose successive generations have been named CHESS 2.0, . . . CHESS 3.0, . . . CHESS 4.0, . . . CHESS 4.9 (the first digit represents a working generation, the second digit is a version within that generation), was born in 1968. When the first computer chess tournament took place in 1970, the program proved itself to be the strongest and it maintained this reputation for most of the decade. Occasionally another program would win an event ahead of the Northwestern program but such occurrences were the exception rather than the rule. At the time of writing, this program holds the title of World Computer Champion, which it took from the Russian KAISSA in 1977.

Much of the program's power is due to its great speed. The programmers have devoted much effort to the speeding up of essential processes such as legal move generation and to this end the program maintains a data base which includes, among other things, a list of every square attacked by each piece. This list is updated whenever a move is made in the game tree, and by updating it rather than recreating it, the programmers reduce the time taken to provide the attack and defence lists for the newly-created position. The program also uses a hash table for transpositions, as described in the section on Greenblatt's work.

For some time, the Northwestern program employed a plausible move generator to restrict the number of nodes in the game tree but various reasons prompted the programmers to change to a full width search. One of the prime reasons for doing so was the fact that they noticed certain moves, which appeared good when examined to a depty of (say) 5-ply, but which ranked too low at the root of the tree to be included in the first plausible move list. Chess masters are not faced with this problem because their plausible move generator is much more sophisticated and accurate and I suspect that the chess programs of the future may return to the plausibility approach, unless brute force searching produces an electronic chess master within the next 2-3 years.

The program's evaluation function contains a number of terms which quantify the best known chess heuristics. Material is measured in such a way as to encourage the side that is ahead in material to exchange where possible and to discourage the exchange of material if the program is losing. Another feature gives a bonus for attacking enemy pieces and this bonus is enhanced when an enemy piece is doubly threatened.

Pawnstructure is an important feature of the game of chess at higher levels of skill and any program which aspires to master strength must understand the finer points of pawnstructures. If your pawn formation is rotten your whole position is eventually liable to crack under pressure. This program considers doubled pawns (two or more pawns of the same colour on one file); isolated pawns (pawns that cannot be supported by pawns of their own colour); backward pawns (pawns which do have adjacent friendly pawns, but which are less far advanced than its neighbours); passed pawns (those which have no enemy pawn impeding their progress to the eight rank); and advanced pawns.

Knights, bishops, rooks and queens are given bonuses according to the values of the squares they attack, particularly if the squares are near the enemy king or the centre of the board. Rooks are given bonuses for being situated on open files or on the seventh rank (a rook on the seventh rank usually poses a serious threat to enemy pawns which have not yet moved). The kings are discouraged from moving towards the centre of the board, except in the endgame, and there is a safety feature which determines whether or not a king is well sheltered by its own pieces.

The tree searching routines employ all of the techniques that we have encountered in previous articles: the alpha-beta algorithm, with a 'window', killer moves, etc. In fact the Northwestern program provides us with an excellent illustration of the power of all these neat tree searching tricks — it plays better chess than more than 99.5% of the world's chess playing population and has even won some quick games against International Masters and Grandmasters. These outstanding results have been achieved more through the effects of a cleverly programmed brute force search than as a result of the program's chess knowledge, which is still primitive. The success of the program shows good programming is even more important than an advanced knowledge of the game, when producing a program of the strength currently being exhibited by microcomputers. Certainly it will be necessary for a human chess expert to be involved in the programming of an electronic Grandmaster but there is absolutely no reason why the readers of this column should not write a program that can play respectable chess.

To illustrate the prowess of the Northwestern program I shall offer you the following game, which was its first ever win over a human Grandmaster. The game was played at blitz speed, which requires each player to make all of his moves within five minutes. In fact the rules were slightly different for the two participants — Stean was playing in real time but the program was permitted a total of five minutes for CPU time and satellite transmission time, with no penalty for the time taken by its human operator to move the pieces.

WHITE: CHESS 4.6
BLACK: Stean

1 e2-e4   b7-b6
2 d2-d4   c8-b7
3 b1-c3   c7-c5
4 d4-c5   b6-c5
5 c1-e3   d7-d6
6 f1-b5+ b8-d7
7 g1-f3   e7-e6
8 e1-g1   a7-a6
9 b5-d7+ d8-d7
10 d1-d3   g8-e7
11 a1-d1   a8-d8
12 d3-c4   e7-g6
13 f1-e1   f8-e7
14 c4-b3   d7-c6
15 g1-h1

It is peculiar moves such as this one which make it possible to recognize the play of a computer. A strong human player would never move his king onto a diagonal occupied by his opponent's queen and bishop, unless it was forced.

15 . . .   e8-g8
16 e3-g5   b7-a8
17 g5-e7   g6-e7
18 a2-a4   d8-b8
19 b3-a2   b8-b4
20 b2-b3

If we sum up what has happened so far, it is clear that Black has a dominating position. His pawns control the centre while White's e4 pawn attacks only one central square. Black's pieces are active, White's are passive. But the program has one important advantage — its opponent thinks that to all intents and purposes the game is over and he tries to take the program's position by storm. This is exactly the opposite of the way one should play against a strong program — the tactical search will reveal tricks that the human misses, especially at this breakneck speed.

20 . . .   f7-f5?

#?= COMPUTER ?% ?* ANSWERS ?=

Send your questions to 'Computer Answers', A.P.C., P.O. Box 115, Carlton, 3053.

ROMs and RAMs

I would be grateful if you could answer some questions on chip compatibility:
1. Can static RAM be used as a replacement for dynamic RAM?
2. Can memory space be increased just by replacing one chip with another of a higher capacity?
3. Can unprogrammed ROM be used instead of RAM or does the first usage 'fix' it?

D. Johnson.

1. In theory it can, but there are problems. First, static RAM chips aren't pin-compatible with dynamics, so you'd have to make a separate PCB on which to mount them. Secondly, you get fewer bits per chip with statics, so you'd have to make sure the addressing was reconfigured correctly. And lastly, static RAMs use more power so you'd have to check whether your system's power supply could cope. Incidentally, it isn't possible to use dynamic RAMs in a system designed for statics, as dynamics require a refresh signal which probably wouldn't be available, unless you built a circuit to provide it.
2. It is sometimes possible to fit larger-capacity memory chips into the same sockets as existing ones. However, you'd need to sort out the addressing; on some computers this is simply a matter of changing some links but with others it's practically impossible.
3. While the computer can alter the contents of RAM (and the contents are lost when the power is switched off), ROM has its contents permanently fixed, either during manufacture or, in the case of EPROMs, by an electrical process using a special programming device. ROMs are therefore useful for storing anything which you want to become a permanent part of the system (such as a monitor or, in some machines, a whole Basic interpreter) as it retains its contents when power is switched off. So, if you want to incorporate some software permanently into your system, you can use a ROM (actually an EPROM, which can be erased with ultra-violet light) provided you have access to a programming device. Unfortunately, ROMs and RAMs aren't pin-compatible so you'd have to build a board to house the ROMs.

P. L. McIlmoyle.

PEEK and POKE

I am experiencing a great deal of trouble understanding PEEK, POKE and USR functions on my system. I am getting on fairly well with Basic. Can I damage my computer by experimenting with them as I gather that they put things in, and take them out, of ROM?

G. Nugent, R. Southern and others.

PEEK, POKE and USR functions give you a way of looking (PEEK) at any memory location, altering it (POKE), and running a machine code subroutine (USR). None of these can physically damage your system, but random or unskilled use of POKE will almost certainly corrupt your Basic interpreter, Basic program, or some other critical routine, making your system crash sooner or later. Your letter says 'putting things in ROM'; just a small point but important nonetheless: you cannot put things (POKE) into Read Only Memory, you can only look at (PEEK) its contents. POKEing it will have no effect.

You can write machine code programs and POKE them into RAM from a suitable Basic program. As a machine code program runs more quickly than its Basic equivalent, this is particularly handy for things like animated graphics displays. You must, however, consult your computer's manual for details of where in RAM the machine code can be POKEd. Then you can activate the machine code program from Basic using USR. The format for USR varies from machine to machine but it's often something like USR(N), where N is the starting address of the machine code.

Using PEEK, POKE and USR will need a deeper understanding of your computer than Basic programming. It is not easy to go much further in a reply like this. Join a local user group/club as it is far easier to be shown than to have to struggle on your own.

Sheridan Williams

Mathmatical micro

Can you give me any problems to work on using my micro. They are best kept to something mathematical, but I would prefer to try something that no-one else has yet solved; are there any such problems?

T. Hutchinson.

Try these:
Has $x^4 + y^4 + z^4 = N$ got any whole number solutions?
Has $x^4 + x^4 + z^4 = N$ got any whole number solutions, where N is an exact fourth power?

Let's hope they don't keep you awake all night.

Sheridan Williams

Data difficulty

I have an Apple II and recently bought a 6502 manual and assembler with a view to writing subroutines for Basic programs. I cannot see how to pass data and variables (strings in particular) between Basic and assembler.

Miss H. Prince.

You have hit on one area that is lacking in many micros, the Apple being no exception. However, all is not lost, as page 137 in the Applesoft manual explains all.

Let us consider variables only. Whichever variable is defined *first* the program can be accessed via locations hex 69 and 6A. However, only the first one can be located in this way. Let us assume that line 0 of our Basic program is 0 MDS = "Mike Dennis". At locations 69 and 6A will be found two bytes that, together make up an address where MD$ can be found. This address depends on the size of the program but whatever value this address is, it can be found from these two locations. Let us assume that location 69 holds 9E and 6A holds 35. At address 359E will be found the following data, ASCII M then ASCII D at location 359F. The $ isn't stored. At location 35A0 will be found a byte whose decimal equivalent is the current length of the string (in this instance it will be 11) which explains why strings have a maximum length of 255. The next two bytes hold the address of where the string will actually be found, say 8E98. This address will dynamically change every time A$ is referenced by the program but we can always find this address via 69/A. Try writing simple programs and then looking at the various memory locations either from Basic or alternatively via the monitor.

The next two bytes are set to zero; this is to leave room to store real variables. Other variables can then be found on seven byte increments from the address given at 69/6A but you do have to know in what order your variables appear in the program.

Mike Dennis

Adventurous builder

I am an electronics technician and have a good knowledge of digital techniques and logic. I would like to build and design my own micro so that I could experiment with the basic hardware and all levels of programming languages from machine code up. With the software in mind, what considerations must be given at the design stage to the eventual language to be used? Which language is Adventure written in, and how much memory does it require?

M. McKenzie.

I would think very hard before setting about designing and building your own micro. You will certainly not end up saving yourself any money by doing so. There will also be many points that you will miss in the design stage which will severely limit the uses for your eventual system. However, please don't let me put you off as there are many good reasons for embarking on such a project. One of the main considerations is whether you want to concentrate on the software side more than the hardware, because if you do, then I would recommend that you look at one of the many single-board systems currently available. Your letter emphasises that you wish to experiment with languages and so it would be advisable to think hard before too many irreversible decisions are made. A friend of mine has taken the course of designing and building his own and already it has taken him six months, several hours a week; added to that there are several points he would change if he could.

As far as languages are concerned, you will have to master machine code, but you can ease this if an assembler is available. I would opt for a system that supports Forth as this language has all the advantages of machine code, is compact, runs very fast but has high-level type instructions to speed program writing. Make sure that the system that you choose has a very good and comprehensive manual, as this will be of utmost importance to you.

Adventure source code is usually written in Fortran, and it was originally used on mainframe computers where 'main store' is unlimited compared to micros. For that reason, most versions call the file into main store and execute without recourse to files. This requires around 100k of main store (32 bits) as far as I can gather. There are many pruned-down versions now available on micros but most require a disk system.

Sheridan Williams

Spellbinder

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MAGIC WAND

Continuing our word processor Benchtests, Peter Rodwell reviews a soon-to-be-released CP/M based system.

Magic Wand is a very comprehensive word processing package produced by Small Business Applications Inc of Houston, Texas. It runs under CP/M and is one of the most versatile micro-based word processor systems today.

This test was carried out on a 64k Intertec SuperBrain running CP/M 2.2, with twin double-density minifloppy disk drives and an Epson MX-80 dot matrix printer. The version of Magic Wand tested had been specifically adapted to the SuperBrain and the computer itself had a set of special function keys replacing the normal numeric and cursor control keys.

Magic Wand comes as two separate programs: a text editor, with which you prepare your text, and a text formatter, which types the text in a format specified by you during the editing stage.

Editing

The editor is called from CP/M simply by typing EDIT and the file name, which can be either a new file or one already existing. You can type a second file name on the same command line and the results of your efforts will then be saved under this second name, which is useful if you want to leave the original file unaltered. Otherwise Magic Wand saves text under the first file name and preserves the original file as a back-up.

Once the editor has been loaded, you're asked to insert the disk holding – or to hold – the text file and if the editor can't find the named file on the disk it asks you to confirm that you're working on a new file; this ensures that you'll notice if you intend to work on an existing file but had accidentally inserted the wrong disk.

You then find yourself looking at the command screen, which shows you what files are in use, the number of words and characters in the text buffer, the number of characters remaining and the current line length and tab positions.

A range of commands can be executed from the command screen, most of which are activated by only one or two letters. Typing an illegal command or a "?" causes a menu of all commands to be displayed; typing a command followed by "?" provokes a terse, single line explanation of the command.

Having set up the screen line length and any tabs you need, you move from the command page by pressing return. If you're working on an existing file, you find yourself at the top of text; with a new file, the screen blanks disconcertingly – the electronic equivalent of a fresh sheet of paper!

The Magic Wand editor provides all the facilities one expects from a good screen-oriented word processor. There's no need to hit return when you near the end of a line as the system has automatic word wrap-around – if the whole word won't fit onto a line, it's completely transferred to the start of the next line, which aids readability tremendously. Not pressing return takes a little getting used to but it speeds up editing significantly; you can, of course, use return to force an end of line – at the end of a paragraph, for instance.

Special function keys are provided for all the inserting and deleting. You can insert/delete a character at a time simply by positioning the cursor at the appropriate place and pressing the required key; the line is opened or closed automatically on the screen as you type. A 'full insert' key opens up several lines on the screen to allow you to type in large chunks of text – the mode is cancelled by hitting the same key again. Other keys allow you to scroll back and forth both a line and a page at a time, while another pair provides an instant jump to either the top or the bottom of the text.

Search and replace commands are provided via a special key, pressing it drops the cursor to the bottom line of the screen and you type in the strings to be searched for/replaced on this line. Search/replace operates on the text between the cursor position and the text end. A repeat search key is provided and is self-explanatory. Replace will take place on all occurrences of the specified string or on a specified number of occurrences; a query option is available, which allows you to miss out on some occurrences if you wish.

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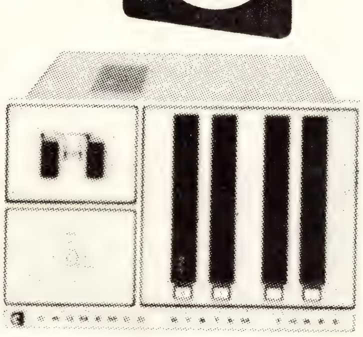

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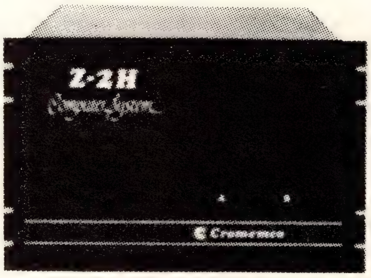

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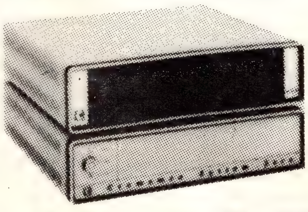

SYSTEM ZERO WITH DDF
Two Disks
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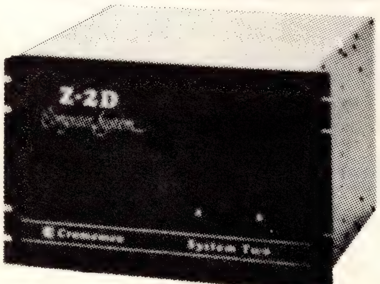

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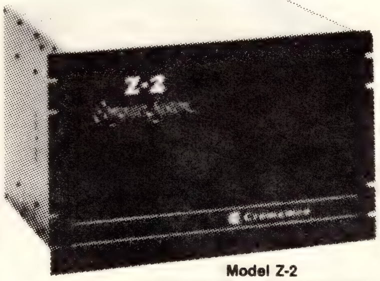

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Two commands deserve special mention. The Include command allows you to specify a file and incorporate all parts of it into your text. Thus you can have a file of standard paragraphs on disk and select from them as you compose your text. The system displays the text to be included and gives you the option of either slotting it in or moving on to other parts of the Include file.

Spool enables you to print and edit simultaneously. Having edited one file and saved it on disk, you can then get on with editing another, using Spool to print out the first one. The theory's fine but I found it nearly unusable since the system gives priority to servicing the printer with the result that response to the keyboard slows down dramatically, to well over a second between pressing a key and the character appearing on the screen, in some cases. It's pretty debatable whether using Spool would actually save you any time.

The block commands are straightforward but only allow you to have one block active at a time. Yes, there's a special key to insert block markers but these have to be deleted by returning to the command screen and using a special command after you've carried out your block operation.

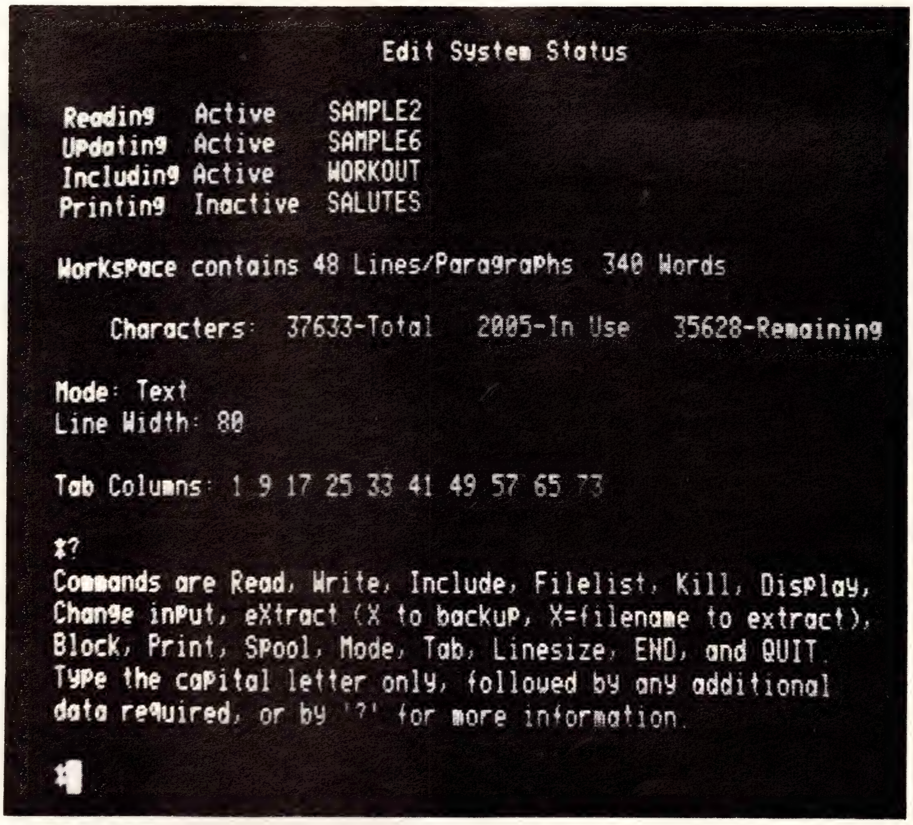
The editor allows you to print a draft copy of your text; the printout is exactly what you see on the screen, which means that any embedded formatting commands (see below) are printed instead of being executed.

The text buffer holds 37,633 characters, just over 6000 words or 13 single-spaced A4 pages. Once the buffer is full (you're warned in advance) you must save the text to disk and continue on a new file. Magic Wand won't handle a file which is larger than the text buffer. If you're working on very long texts you may find this a trifle annoying as you'll have to split text into chapters or sections; it does mean, of course, that while you're working on chapter nine you can't zip back to chapter three to check what you said there. On leaving the editor, you are given the choice of saving the text on disk, either as a new file or as an update to an existing file, or of simply quitting without saving the text.

Formatting

Having prepared your text with the editor, you must first save it on disk before running the formatter program, which is called simply by typing PRINT followed by the file name.

At this point an annoying inconsistency manifests itself. Once again, Magic Wand invites you to mount the disk containing your text file and press return. However, the formatter has no equivalent of the editor's command screen so, assuming the text disk is mounted, printing starts immediately after you hit return. Printing can, however, be aborted and you can start all over again, this time prepared for the fact that instead of hitting return, you can also enter commands: one allows you to preview the formatting instructions embedded at the start of the text and alter them if necessary, although if other commands occur later in the text, they will be executed when the formatter gets to them.



```
                    Edit System Status

Reading   Active    SAMPLE2
Updating  Active    SAMPLE6
Including Active    WORKOUT
Printing  Inactive  SALUTES

Workspace contains 48 Lines/Paragraphs  340 Words

    Characters: 37633-Total   2005-In Use   35628-Remaining

Mode: Text
Line Width: 80

Tab Columns: 1 9 17 25 33 41 49 57 65 73

*?
Commands are Read, Write, Include, Filelist, Kill, Display,
Change input, eXtract (X to backup, X=filename to extract),
Block, Print, Spool, Mode, Tab, Linesize, END, and QUIT.
Type the capital letter only, followed by any additional
data required, or by '?' for more information.

*
```

The editor's command page (see text). Shown at the top are the input and output file names; part of another file ('Workout') is being included and a fourth file is being printed in the background. Also shown is the commands 'help' menu.

As well as entering the formatting commands after calling the formatter, you can also insert (embed) them into text during editing; they are separated from the actual text by the '/' character. If you happen to want to print that character, you can define a different character (or no character at all) as the command recognition character. Various other characters with special meanings, such as '&' for ghost hyphernation, can also be changed at will at any time in the text file. The formatting commands themselves an be entered either as abbreviations or in full to make them readable to less experienced users.

Magic Wand has some very sophisticated formatting capabilities as well as the usual ones provided by most word processing systems. Thus you can not only specify either justification (both margins even) or range right (ragged right margin, as produced on a normal typewriter) but you can print out range left, with the right margin lined up and the left margin ragged, a sort of 'mirror image' to normal typing!

The system gives you total control over the page layout, although there's a minor, initially annoying inconsistency with the margin commands: lm10 sets the left margin at the tenth column of the page but rm70, instead of setting the right margin at the 70th column as in most systems, actually sets the *line length* to 70 characters, so the right margin is the 80th column. Top and bottom margins can be defined and you're given the ability not only to paginate but to place the page number anywhere you want to, even half-way through the text if you so desire. Magic Wand caters for text and paragraph indentations and allows you to centre lines or whole blocks of text between the margins. You can produce both page headings and footings of however many lines you require. Line spacing can be set to any number from one to six.

An extensive range of commands is available to control the printer. These range from a simple OUT command, which enables you to send out any ASCII control codes you like, to some very sophisticated commands for equally sophisticated printers, the expensive sort with proportional spacing, bolding, underlining, super- and subscripting capabilities, etc – Magic Wand caters for all these features. This allows you to produce justified text where the justification is achieved by varying the spacing between letters rather than by adding spaces between words, as is done by cheaper printers. Using Magic Wand with an expensive daisywheel printer, you could easily produce camera-ready artwork for printing which would feature some extremely sophisticated formatting and be virtually indistinguishable from properly typeset work.

Other commands available include: a draft facility, which allows you to print a file containing speciality printer commands onto a faster dot matrix unit so you can check the formatting; the choice of printing onto continuous stationery or of pausing after each page to allow the insertion of single sheets into the printer; and the ability to print multiple copies of the same document, with or without a pause between copies.

As the Epsom dosen't permit variable spacing between letters, justification was performed by adding spaces between words and Magic Wand seemed to do this particularly intelligently, frequently inserting the extra spaces after full stops or in the middle of lines instead of just at one end of the line;

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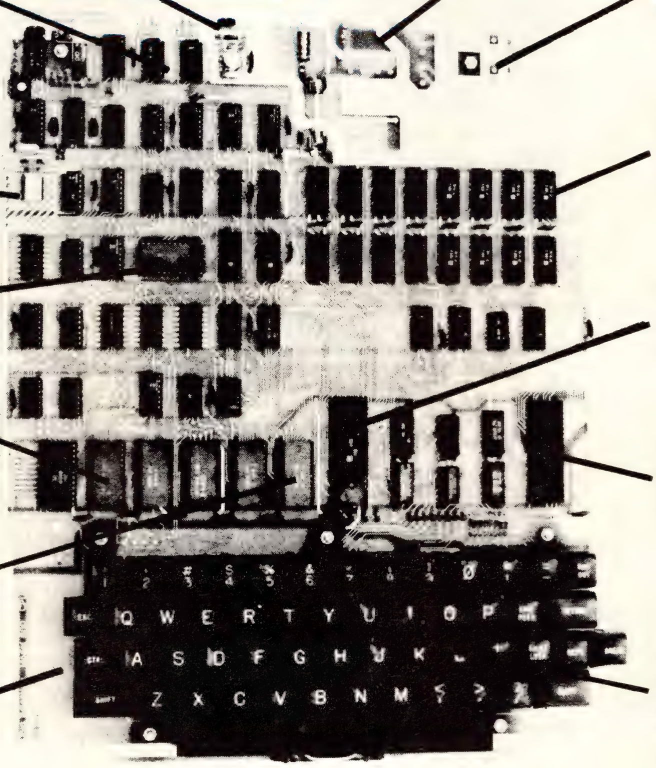

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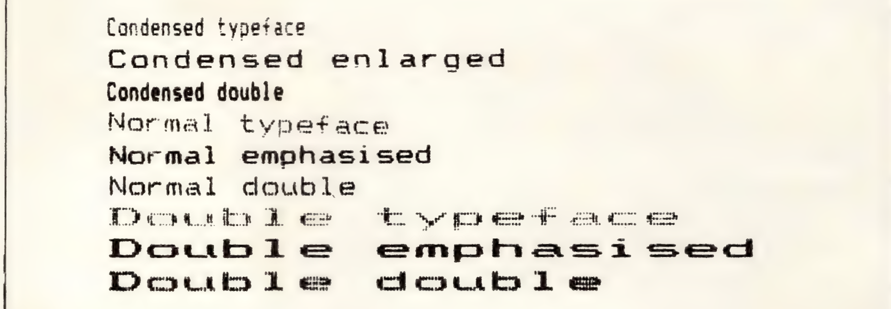

Condensed typeface
Condensed enlarged
Condensed double
Normal typeface
Normal emphasised
Normal double
Double typeface
Double emphasised
Double double

Fig 1 Sample typefaces from the Epson MX-80.

the result is a very neat printout.

Various facilities are included to make life easier for the operator. You can insert comments into the text file which will not be printed during formatting; NOTE prints a message to the screen only; WAIT stops the printing (you can add a prompt which will appear on the screen); and SHOW prints on the screen the current values of any variables (see below) you specify, together with whatever explanatory text you require.

Summarising, the Magic Wand formatter is extremely powerful, as powerful as any user is likely to require without having to resort to full typesetting facilities; it enables the user to produce simply-formatted documents with great ease and complex formatting with little extra effort.

Files and variables

If the features I have described so far were all that Magic Wand offers, it would still be a powerful tool for many in the form of the provision for variables with accompanying commands which are on the verge of being a programming language, plus the ability to set up files which can be referenced by Magic Wand as it is printing text.

Files are set up using the editor as though they were pieces of normal text. The files can be either 'data', such as names and addresses, together with other details such as the salutation used for each person ('Dear Mr Harris,' or 'Dear "Bazza",' for example) and any other details of text which you might wish to incorporate into standard letters to customise them.

There are four types of variable: string, numeric, formatted and system and you can have up to 128 variables in any one file. String variables can be up to 55 characters long (you can set them to shorter lengths to save on memory space) and you can reference the first n characters of a string. Numeric variables are positive integer only in the range 0 to 32767. Formatted numeric variables, used mostly for amounts of money, are printed out to two decimal places with commas – 10000.5 would be printed as 10,000.50, for example.

These variables can have their values set in different ways: in the text file, using the SET command; from the keyboard when you run the formatter, using the GET command; or from a data file – it's this last capability which makes Magic Wand a very powerful tool indeed.

The system variables are for page number (the only one alterable by the user), the pass number for when you're printing multiple copies or a document, the current file record number being accessed, an end of file marker, current line and column numbers and the number of lines left on the page. You can use this last to force a new page before printing a heading if there aren't enough lines of text after it – that way you avoid ending up with a heading on the last line of a page.

Coupled with the variables are conditional commands which allow you to test for a condition and act according to its value: IF NAME = "Fred", SKIP 4 would skip the next four lines if the value of the string variable NAME was "Fred", for example. So, you can get variables from a file of, say, names and addresses and print one of a variety of different paragraphs according to the variables's value.

You could use Magic Wand for many applications without ever using the variables feature; with variables, you have a word processor of great sophistication and power which would provide a very useful tool in a business environment.

Learning and documentation

As you will have gathered from the above, if you want to exploit the full potential of Magic Wand, you have a lot of learning to do. Fortunately, this is made very easy by what must be one of the best examples of documentation in the micro world.

The first two-thirds of the manual are a series of lessons which take you step by logical step through all of Magic Wand's abilities. The lessons use a series of text files which come on the disk with Magic Wand – you play the part of Abraham Lincoln's secretary, working on a draft of the Gettysburg address, which you have to polish and alter until the actual address results. You then go on to set up standard replies to various types of letters (from friendly to threatening) and a file of names and addresses so that each person gets the reply he deserves.

At each step you're given a photograph of what the screen should look like and reproductions of the printout produced by it. These are very useful for checking that you're actually doing what you're supposed to be doing.

The lessons are structured so that you can drop out at whatever level meets your requirements – there's no need to wade through files and variables if you want to use Magic Wand for straightforward text editing and formatting. Great care has been taken to explain any technical terms in full as they arise so that the complete novice can sit down with the manual and feel quite at home with the system from the start.

The final section of the manual contains summaries of the editing, formatting files and variables commands. Two of the commands which appeared on the editor's command screen were nowhere explained in the manual but this apart, the summaries were well-written, logically laid out and easy to use.

The book also includes a brief introduction to CP/M explaining all the features which are likely to be of concern to Magic Wand users.

Users

Because of its wide-ranging facilities, Magic Wand should prove useful to all four of our 'standard' users (outlined in the introduction to this series), although some of them would have to accept certain limitations.

The text buffer capacity of just over 6000 words could be regarded as a handicap unless you accepted the minor inconvenience of working by chapters and storing them as a series of separate files. The author/journalist would be most affected by this feature and in fact this user would be unlikely to make use of many of Magic Wand's capabilities, especially the files and variables facilities. On the other hand, many authors would find the hardware/software configuration attractive – Magic Wand is easy to learn to the level required for this use and the SuperBrain, with its integral construction, sits tidily on a desk. The Epson is a very civilised little printer for this application.

For the report writer there's again the 6000 word limitation but this is probably less of a problem than for the author. Again the report writer would probably not use the package's more sophisticated facilities but the very extensive formatting features would be of immense value in this application. Coupled with a high-quality daisywheel printer (the Epson would be useful only for rough drafts to check formatting), Magic Wand should fulfil most report writer's needs.

The manager would also find Magic Wand useful, although he would certainly use only a few of its capabilities. His requirement for quick and easy learning is more than met by the excellent manual and, of course, the extra facilities are still there for him to get to grips with for urgent work on the secretary's day off. The Epson would be at home in the manager's office for draft work since it's neat and unobtrusive.

In the introduction of this series, I said that the secretary is probably the most demanding of all four users. Magic Wand has been devised quite clearly for use in a busy commercial environment and would meet most requirements in this area. The system is friendly and foolproof but it's probable that, to make use of its full facilities, the secretary would want to go on some kind of a course – although the manual is certainly sufficient, a busy office is hardly the place to sit and learn the advanced features Magic Wand offers.

Hardware

The SuperBrain was Benchtested in APC, November 1980 so I shall not go into its technical features and will concentrate on its suitability for word processing.

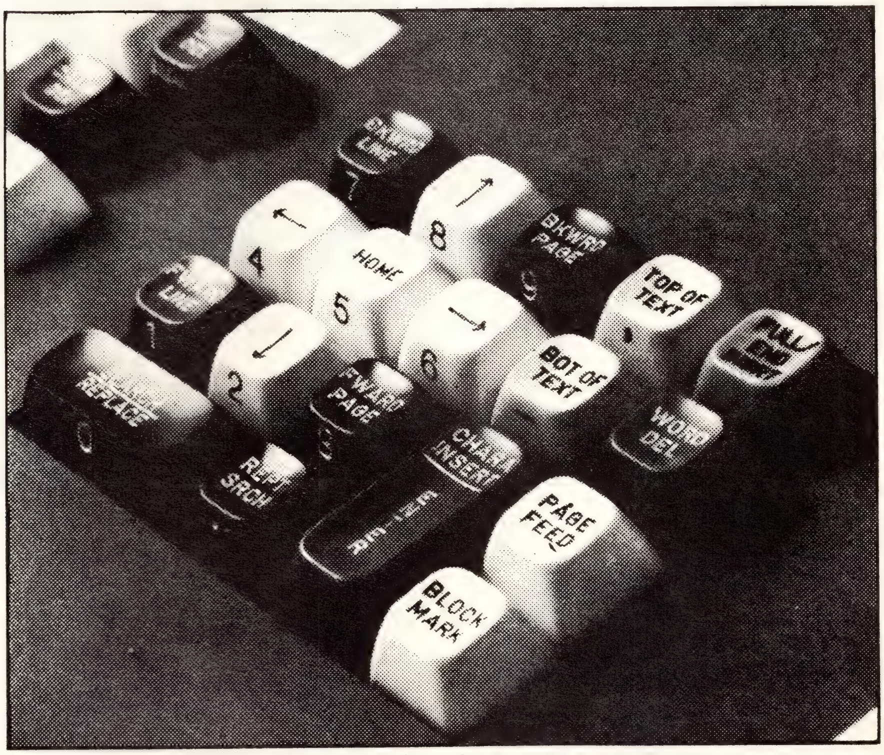
Firstly, the keyboard felt a little flimsy to me – the keys have a very light touch and a rather tinny feel to them.

The display was quite civilised, having a matt-finish screen to cut down reflections and a brightness control at the back of the machine. The character set is a little odd; characters such as ‘g’ and ‘y’ have proper descenders but these don't actually descend – instead, the characters are raised so the bottom of the descender aligns with the bottom of other characters. The overall effect was most graphically described by Sue Eisenbach in her Benchtest as ‘vaguely ransom note’ but the novelty quickly vanishes and after a couple of hours I didn't even notice it.

The disks each have a capacity of 179 kbytes, about 25,500 words or 56 A4 pages (single spaced), which is probably adequate for many people. The disk drives on the model I tested were permanently running – this creates noise (not too much) but, more importantly, increases wear both on the disks and the drives themselves. You can reduce disk wear by removing the disks once you've loaded the programs and text but drive wear might prove a problem. Some models of the SuperBrain have been modified to turn off the drives when they're not required so this problem won't apply to those.

Any cheap printer with an RS232 interface will plug straight into the SuperBrain's auxilliary port. Another RS232 port is provided which makes linking to other computers, directly or via modems, quite easy. High quality daisywheel printers can also be hooked up and, because the SuperBrain comes all in one box, there'll be a minimum of trailing wires to trip over in the office.

The Epson MX-80 is a very nice printer. It's very well made, as one would expect from Japan these days, is compact, light and very quiet. As the Benchmark results show, it's not particularly fast despite its bidirectional printing but the print quality is very good, as shown in Figure 1. Quite a variety of typefaces are available by sending sequences of control codes; of these, the emphasised condensed gives very dense, black characters which would, at a pinch, pass for correspondence quality for those not-too-vital letters. By changing switch positions inside you can get standard ASCII, English, French, German and Japanese character sets, the European character sets differ in that the English set gives a ‘ ’ sign instead of a ‘ ’ and the others provide accents and umlauts. TRS-80 graphics are also in there, unless you set up for Japanese characters, which replace most of the graphics. Depending on which character set you choose, the Epson prints over 40, 66, 80 or 132 columns and takes paper from 4in to 10in wide, I tested the F/T version, which has both pin and friction feed; these mean that, by disabling the paper-out sensor (with a special control code or a screwdriver), you can print on single sheets. The printer will accept one original plus two carbon copies. It uses a cartridge ribbon which is very easy to fit and the print head can also be replaced by the user – the manual tells you how to do it and replacement heads cost about $40. The bell, incidentally, is *very* loud.



The special function keys, which replace the SuperBrain's numeric pad.

Summary

Magic Wand is designed specifically for commercial use and as an office tool it's a winner, providing a wide range of extremely powerful facilities. The secretary will be its heaviest user but the report writer will also find it very useful for its powerful formatting capabilities. Thanks to the excellent manual, most users should have no trouble in learning the system to whatever level they require.

Coupled with Magic Wand, the SuperBrain is very good for word processing, especially when fitted with the special function keys, which make a major contribution to the system's ease of use.

The Epson is a very nice printer, certainly one of the better low-cost dot matrix printers on the market today. For draft or manuscript production it's ideal, but serious users will require a daisywheel unit to produce correspondence and report quality material.

WP Benchmarks

Magic Wand/Intertec SuperBrain

WP Test*	Base	Buffer full	DF1 (n=2)
1	24.5	37.3	0.7
2	24.3	39.5	0.8
3	1.2	1.3	0.5
4	1.0	1.7	0.9
5	3.0	5.5	0.9
6	3.1	5.9	1.0

All times in seconds

Epson MX-80 F/T printer test*

Claimed printing speed: 80 cps
Tested speed: 45 cps (485 words/minute)

* See May 1981 APC for details of WP Benchmark tests.

Prices

Intertec SuperBrain, 64k RAM, twin 5¼in disks:	$5,500
Epson MX-80 F/T printer:	$950
Magic Wand:	

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Brookvale	93 0441	Adelaide	212 1962
Wollongong	28 3800	Perth	328 6944
Blakehurst	546 7744	Cannington	451 8666
Auburn	648 0558	Newcastle (Opening Soon).	

DSE 947

NIGEL SHEPHERD ON commodore

Nigel Shepherd, managing director of the Commodore Information Centre, talks to APC staff.

After nine months operating in Australia, the Commodore Information Centre is firmly established as one of the leading local marketers of micro computers. Managing director, Nigel Shepherd says he is 'very strongly convinced' that by the end of the year Commodore will be number one in Australia.

"The reason is that our product line is expanding so dramatically that there is no way the Tandys, Apples or Dick Smiths of this world are going to be able to match the range of products we offer," he said. "Currently our market share is very difficult to estimate but I would say that in sheer numbers of machines sold, Tandy is probably leading at the moment, then Apple, ourselves and Dick Smith. Tandy, Apple and Commodore probably have about 70 per cent of the market. Add Dick Smith and you are probably talking about four companies having as much as 90 per cent of the overall market. I don't think we are number one yet, but I would be fairly positive that by the end of the year we will be."

Established in September last year, the Commodore Information Centre is a wholly owned subsidiary of Commodore International Ltd, the American based microcomputer system manufacturer, renowned for revolutionising the microcomputer industry with the introduction of the PET computer – Personal Electronic Transactor.

Commodore International reported a 77% increase in sales last financial year and is currently on target for a further increase of around 60% for the 1980-81 fiscal year. This will bring the annual turnover to over the $200 million mark. Sales for the six month period to December were $80.25 million – more than two thirds of the previous $125 million return for the fiscal year 1980 and $9 million above total sales for 1979.

Today Commodore has the second largest number of installed microcomputers in the United States and has consolidated itself as the microcomputer leader in the under $10,000 range in Britain and Europe. An assembly plant has recently been established in Braunschweig, West Germany, to facilitate supply and service to this expanding market.

Commodore first entered the Australian market in 1978 via Hanimex who operated the agency for Commodore products. The division was managed by Nigel Shepherd. Commodore's decision to open its own outlet in Australia came about for two major reasons, Shepherd said.

"Basically it was due to the fact that Commodore was expanding fairly rapidly and could see that considerable investment was required on the local scene. It's not easy to ask a distributor to put that kind of money in when he hasn't the security of tenure for that product line on a guaranteed long-term basis.

"The other point was that Commodore was looking to provide a base here in Australia for the whole Asia-Pacific region. Apart from marketing within Australia, Commodore locally was also responsible for New Zealand, the Phillippines, Indonesia and Singapore. Australia provides a base for these parts of the globe." The Commodore company was originally started in Canada some 20 years ago to manufacture typewriters. It later moved out of typewriters and became the North American distributor for Casio calculators.

"Commodore was doing very well with Casio, in both Europe and North America," Shepherd said, "but planning ahead and trying to avoid the distributor coming in and saying 'thanks very much, you've done a great job for us, but now we're opening up our own company and coming in direct' Commodore decided to go out and source its own parts to produce its own calculators.

"When the Japanese moved into the market the situation changed dramatically. Calculators that were previously selling for $200 to $300 dropped to $100. The result was that of 20 or so calculator manufacturing companies, there were only about four or five survivors. It certainly affected Commodore's business, and affected it fairly severely. However, recognising that the calculator market was going to be divided between the Japanese companies, Commodore looked to diversify further.

"The outcome was that Commodore bought Morse Technology, a manufacturing company basically involved in producing the intelligent chips found in calculators and computers. It was a fairly small and compact company with a high degree of technology. Commodore moved into the semi-conductor business, producing the chips which were essential to the development of the calculator. They provided the manufacturing facilities because, although at that time there were a number of companies making the calculators, there were few producing the chips – and the product is not much good without the intelligence.

"When Commodore bought the company it also inherited electronics engineers with considerable expertise and a dream of producing a personal computer. The financial backing from Commodore enabled the PET to be evolved and, I don't think anyone would argue this point, the world's first personal computer was released. First year sales were about $25 million and the revolution which is now known as the personal computer industry had begun. From there the Tandys, Apples, Sorcerers, you name it, followed."

The PET was a small compact machine, totally contained in one box – the computer itself, the keyboard, cassette recorder and the screen were contained in one unit. It was the beginning of the personal computer industry which today is estimated to see sales increasing at a rate of 50% to 60% a year in the United States. More than one million computers have already been bought in the US, at prices ranging from $500 to $10,000. By 1985 small computers are expected to be a $9 billion a year business, according to a California based research firm.

In Australia, Commodore's operation is based at Artamon, Sydney. The headquarters operate with a staff of 13, with a network of 60 authorised dealers covering all capital cities, most major country centres and smaller country areas.

"Our dealers range from small husband and wife partnerships selling only Commodore products, to large office equipment houses," Shepherd said. "We sell only through dealers. There is no direct selling at all. Our forte is in providing support to the dealers. We have a very compact team and our expertise is in servicing the equipment, in the software design and basically the sales expertise. It is our job to pass this expertise on to the dealers and we can keep the operation pretty much under control by working from one headquarters.

"We find that the potential of micros is gradually coming to the fore and several traditional computer dealers are now selling Commodore micros," he said. "The potential sales of micros, in dollar terms, has got to be so much more than the minis and the mainframes. Micros take computers out to the masses, to the people who normally wouldn't use them. I think that previously micros have had the connotation of 'toys', but in the past two or three years this has changed. One of the main messages we are trying to get across, is that micros should not be disregarded because they are smaller or less powerful than the mainframes and the minis. We don't try to pretend our machine is as powerful but it can certainly do a good job. It's like equating a mini car with a Rolls Royce. The Rolls Royce might have particular advantages, but there are more people driving minis than Rolls."

Commodore has achieved particular success in the pharmacy, dentistry and motor vehicle areas. One Commodore dealer, Sydney based Vision Management, has installed over 100 Commodore systems in pharmacies, and the sales rate is still increasing. The hobbyist and scientific markets have not been neglected. The PET continues to sell well and Shepherd reports sales of more than 300 units in the December/January period – normally a poor time for computer sales.

Designed primarily for the hobbyist, the PET has been taken up very substantially by education establishments overseas. Shepherd said, "It is beginning to happen in Australia now and is a market in which we feel we have stronger inroads to make. When we started in Australia there was a ready market for small business systems. It was already set up so we concentrated on that area. It is only now that we're really beginning to look at the education market. We haven't been as successful in education in Australia as Commodore has been overseas, but it's been purely a matter of priorities for us since our establishment here."

Although Shepherd is in the business of selling Commodore products, he sees a major responsibility in preparing young people for computers in society. "About 90 per cent of children will come into contact with computers in some way," he said. "We should do our bit to ensure they understand and benefit from that. We are trying now to gear ourselves to education. Basically the role of education is to produce children who are capable of handling the outside world when they leave school. When the kids leave school most of them will finish up in a job which in some way utilises computers. Personnel involved in education are realising this now and saying 'hey, if we're really going to prepare people for the outside world, apart from teaching history, geography and so on, we should also be teaching them something about computers.'

"So, apart from companies like ours trying to sell computers into education, there is a very strong lobby from within education itself. The problem previously was that a mini computer cost twenty-four or twenty-five thousand dollars and schools simply could not afford one. Then the PET came out at $795 and suddenly the schools found they could afford a computer – certainly not one as powerful as a mini but still capable of teaching the basic skills. That happened in 1977 and Commodore is continuing to develop new products," Shepherd said. "After the release and subsequent success of the PET, Commodore realised there was a market and demand for a more powerful computer. People wanted to accomplish greater scientific equations, use it for business purposes such as stock control and accounting. As a result, the Commodore 300 series was released in '78. The computer incorporated a disk drive to give extra capacity, plus a printer which provided the facility to printout information.

"In 1980, Commodore released the 8000 series computer which was really just moving further up the scale." It is the largest and most powerful system to date with one megabyte capacity dual disk drives and high speed dot matrix printer complementing the 80 column screen. Business software currently available for the 8000 system includes debtors, stock control, budgeting, mailing list and word processing packages. The accounting packages are written locally by I.M.S. Computer Systems in Melbourne, and the total cost is around $10,000. To support the word processing package, the 8000 is interfaced to the Ricoh RP1600 daisy wheel printer supplied by Remington Office Machines.

"Later this year we will release communications software for the 8000 series which will result in the use of the product as a low-cost, efficient, intelligent terminal to larger host computers," Shepherd said.

Commodore has also released details of a larger computer to be released later this year. "It's being called a micro-mainframe," he said, "and will put us into an even stronger position as far as business applications are concerned."

"A new computer geared for the hobbyist market has been released by Commodore in Japan, will be released in the US and European markets May/June, and is expected to be released locally July/August. It will sell on the Australian market for about $399, and incorporates high resolution graphics, a full-size keyboard and has virtually everything our opposition offers," Shephers said. "Already it looks as though it may revolutionise the hobbies computer market in the States and we're convinced it's going to do the same thing here. As far as the hobby and entertainment markets go, we are well catered for."

"So, we are heading down market as far as price and sophistication and simultaneously, upmarket. We are looking to increase our volume in the business area, certainly in education, and make massive inroads.

Shepherd says Commodore is responsible for half the 60,000 microcomputers installed in the UK and claims that there is enormous growth potential in the Australian market.

"The problem previously has been that potential micro purchasers have not been convinced that there is adequate local support in terms of sales, software and engineering. In many respects they have been correct," he said. "Commodore has recognised that the key to success in this market is support and has embarked on a dealer and end-user training program designed to make the purchaser more informed and authorised Commodore dealers better equipped to support our products. In Australia we are experiencing the same sharp upward trend as our parent company. Even in Japan where Commodore competes against the world's largest electronics companies, we hold a respectable share of the microcomputer market.

"Following the surge in customer demand on world markets, Commodore is poised for another record year internationally as well as in Australia," he added.

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PARLIAMENT HOUSE —IN MICRO—

The new Parliament building will be a world leader in innovative structural and architectural design. It has been called "a building for the 21st century" by the Chairman of the judging panel which selected the winning design. But it is not without controversy.

"Do you think we can sell it to the public?", Senator Gareth Evans asked after helping choose the design and "should the nation's most significant totem be configured as back-to-back boomerangs buried in a hillside covered with grass," The Bulletin reported.

In June last year, after more than two decades of arguments, an acceptable design was finally agreed upon by a panel of six judges. The design, by Sydney born architect Richard Thorp, now of the New York firm of architects Mitchell Giurgola Thorp, came out on top over 329 submissions from throughout the world.Cost of the building was originally estimated at $156.4 million. Latest reports put the figure at between $300 and $400 million. Whatever the definitive figure, costs have escalated dramatically, embarrasing the Federal Government and rekindling the continuing arguments over cost and design; leaking roofs and rabbit warren interiors have become an issue for parliamentarians and their public. The eventual choice of design for a new building has, however, been a positive step towards resolving the housing situation.

Work has begun on the boomerang building which will take over Capital Hill. Estimated completion date is January 1988 – to coincide with Australia's bi-centenary.

Australian Personal Computer looks at the role a microcomputer is currently performing in the design and structural developments of this controversial building.

The consulting engineer for the project has installed the first of two Cromemco System 3 microcomputers. The system has been up and running since May last year and current applications include:

- structural analysis and design
- software development (FORTRAN) for structural engineering
- a small volume of word processing
- a modest volume of data base application and report writing.

The software development application includes "general housekeeping" to facilitate the maintenance and development of engineering routines, library and bureau files, as well as file management of a library of 150k (1,000 lines) of FORTRAN.

A second system is to be installed "in the near future" at the design office established in Canberra for the project, according to the consultant and partner in charge of the project *(who prefers to remain anonymous for professional reasons – Ed.)*

"The system has definitely exceeded expectations," the consultant said. "I would recommend it to other professional engineers as being an ideal tool for software development and testing at a relatively low cost. The whole system has proven very easy to use with no need for knowledge of Assembler and no hardware expertise. I was proficient on the system in two to three days and using all the packages to full capability inside two weeks."

A qualified engineer and partner in a structural engineering practice involved in the design of major building projects in Victoria, including BHP House, (the tallest steel building in Australia) and the State Bank of Victoria, the consultant entered the computer world in 1968 when in the US on a study tour. He developed FORTRAN and software for the BHP House design which was almost totally automated, and performed major analysis in St. Louis in the US. An extensive software library for static and dynamic analysis and the design of major steel and concrete structures was subsequently developed, and large frame analysis packages (FRAMEM) were released through the Association of Computer Aided Design (ACAD) which is widely used by consultants throughout Australia.

"In 1976 I installed a TI 745 portable terminal at home in order to maintain and extend the software library. I was using the Compunet Time Share System and although the bureau service was satisfactory, it was very expensive and subject to frustrating line communication problems and a very slow printed (30 cps) output," the consultant said. "My involvement with computers was strengthened further when I attended an Internation Computer Conference in Norway in 1979. It was concerned primarily with structural analysis of very large off-shore oil platforms and sea-going structures using finite element procedures.

"At this conference a paper was presented by Professor E. L. Wilson of Berkeley University (author of the major structural analysis package SAP which is used worldwide), detailing his recent use of the North Star microcomputer as a software development tool, and highlighting its cost effectiveness as a text and character handling tool. He placed particular emphasis on the rapid technological advances and the exciting software developments occurring in the micro-computer area – at costs that were substantially less than those that were current in the lower end of the mini-computer marketplace," he said.

"I came back to Australia to consider the matter, at the same time realising my personal inadequacy in respect to hardware and my complete lack of knowledge of low level languages. In fact, I was really not capable of doing much more than turning the system on or off."

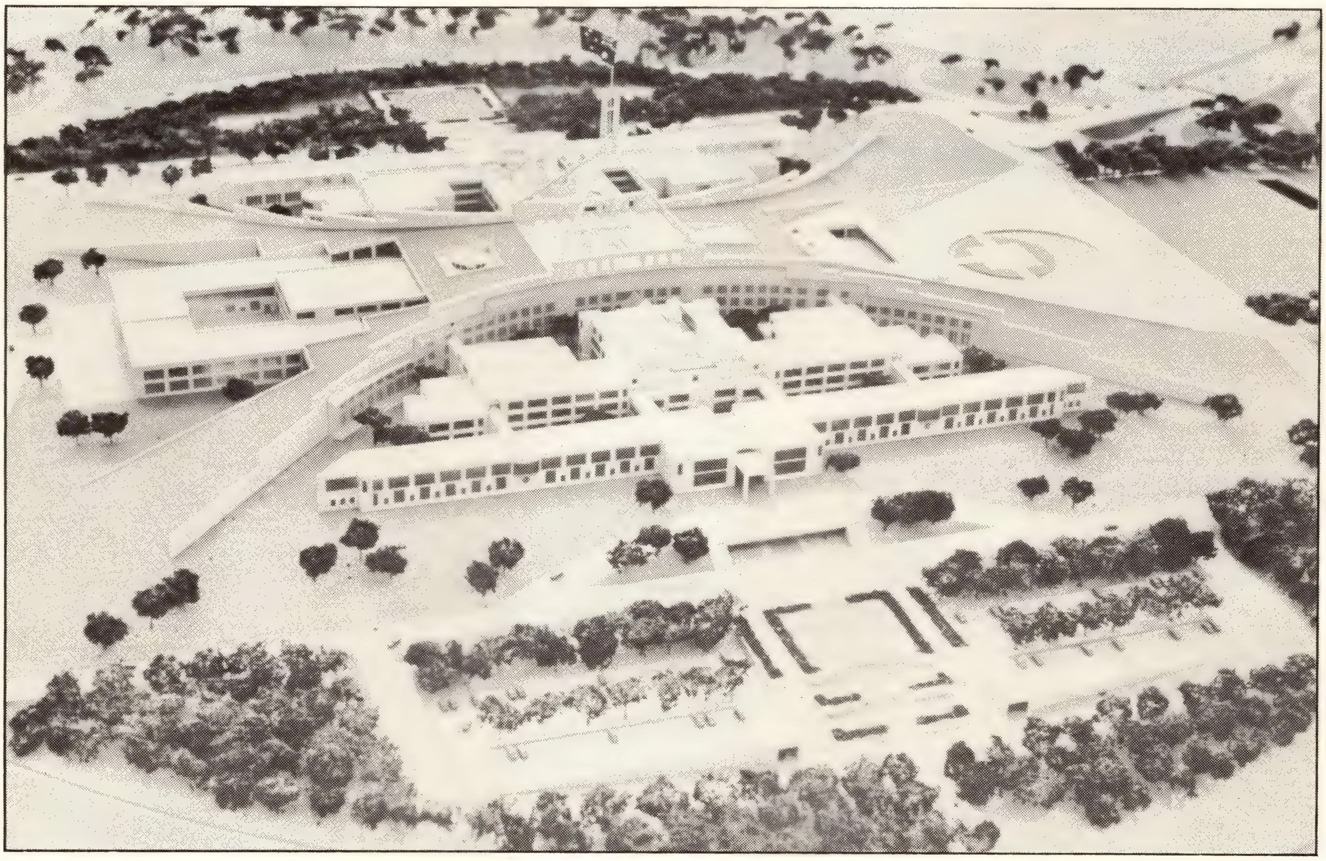
A detailed program of self-education in the jargon of the micro-computer industry followed and the consultant developed a detailed questionnaire which he used as the basis for discussions with leading suppliers, and to isolate uninterested or unprofessional suppliers.

"Initially I explored the Data General MicroNova but turned to 8 bit micros and I finally selected Cromemco, after also considering North Star, as being of sufficient calibre to support my professional operation. Its reputation locally and in the US was for quality and reliability, factors which were documented frequently in good product reviews. Local support appeared to be adequate, and I was impressed with the software support and growth potential of the hardware. The system's modular hardware layout and impressive upward expansion capability were also deciding factors," he said.

The suppliers selected, Informative Systems Pty Ltd, Melbourne, were chosen on the basis of the consultant's personal review of staff and facilities, benchmark tests, and the company's strong interest in the development of his project. The system was installed at the consultant's home in Victoria in 1980, and in January 1981 was moved to Canberra when he was commissioned for the Parliament House project.

The most commonly used design programs (generally about 1,000 lines of FORTRAN each) were converted to the system for release by the consultant's specialist software house – for CP/M based micro systems. Data base files were established for minor project accounting, contacts files, drawing index files, staff records and so on. The major frame program FRAMEM was converted to the micro and is currently being used for the structural analysis of Parliament House.

SYSTEM. The Cromemco System 3 incorporates: 64KB Z80A 4MHz; twin eight inch disks, double sided, single density; Micro-B DM20 intelligent terminal; Qume Sprint 5/55 daisy wheel printer (55cps); Lear Siegler Series 300



dot matrix printer (180 cps).

"The system hardware is easy to use and has proven very reliable," according to the consultant. Early minor problems in the computer powerpack and DM20 have been overcome. The Qume gives continuing problems in the printing of long files. The Lear Siegler is an excellent printer producing high quality upper and lower case dot matrix characters. The disk drives have been very quiet and reliable and provide an adequate transfer rate."

SOFTWARE. "CDOS, the Cromemco operating system, is very simple to use and provides good housekeeping on the disks," the consultant said. "Cromemco software documentation is of good quality but it could benefit from typical examples of applications.

"XFER, the transfer routine, provides adequate transfer speed and is very reliable.

"SCREEN is an effective screen editor with simple on-screen menu commands which I use primarily for editing ASCII files, or when I am in a hurry to edit data files.

"The FORMATTER is a package which I found to be inadequate and no longer useful.

"ED80, by Software Development and Training, incorporates a CP/M line based editor. It is an extremely capable line and screen oriented editor which I use entirely for FORTRAN program development and editing. I find it a first class package, well documented, and more powerful than any editor I have encountered on bureau systems," he said. Demonstration of this package has startled quite a few visitors from all over Australia.

WORDSTAR. The screen oriented CP/M word processor package provides high productivity on short or long documents, according to the consultant. "It is well structured, flexible, easy to use and has all the capabilities required for production of high quality paper work. It is very satisfactory for generation of reports for my low volume secretarial situations."

FORTRAN (Cromemco). The consultant said he has found this 1966 ANSI Standard FORTRAN to be a very satisfactory package. Capabilities are sufficient to support a full engineering application, although the library routines are "somewhat limited."

It compiles rapidly at up to 400 lpm with diagnostics in English rather than a numeric code and provides a good link editor. The largest program currently in use is some 3000 lines of FORTRAN taking 80k in two 40k modules linked by the FORTRAN. It contains some 20 subroutines and can compile, link, and run the entire package in some 3-5 minutes.

The FORTRAN run time is excellent and provides for analysis of structures of up to 50 joints and 50 members for extensive data generation, complex load cases, and the use of Dynamic array storage techniques to maximize problem size in the limited core available with run times generally less than two minutes. "Almost all of our regular used design programs run in five' seconds, that is virtually instantaneously," he said.

CROMEMCO 16K AND 32K STRUCTURED BASIC. "My basic use is limited to minor problems or for simulation of HP45 Basic. However the 32k Basic in particular is very extensive and contains a powerful KSAM package – but I prefer to use the Cromemco Data Base System instead," the consultant said.

"It is a very cost effective package, extensively used for data storage, although somewhat slow on long files and lacking in output reporting capabilities. It has recently been greatly enhanced by the release of Cromemco's DBR (Data Base Reporter) package."

DBR is a high level language which generates in structured Basic with extensive KSAM capabilities. The program allows access to data base files or ASCII files for reconstruction, controlled sorting, data selection/rejection, and reporting in user specified formats. "DBMS and DBR fulfill all my file and data handling needs and are commended to similar users."

INFORMATIVE SYSTEMS. "During consideration of the system, I identified an obvious lack of recognition by micro suppliers of the need for dedicated professional support for the serious user. This lead to my elimination of the majority of the smaller systems and rejection of other potential suppliers of well reputed systems," the consultant said. "My selection of Informative Systems as suppliers has been well founded. The company has an excellent attitude, and its rapid response to problems and questions has resulted in an ideal working relationship and kept me in good shape. I am most appreciative of the support. Strong in-house software support has overcome an occasional difficulty of implementation of system packages.

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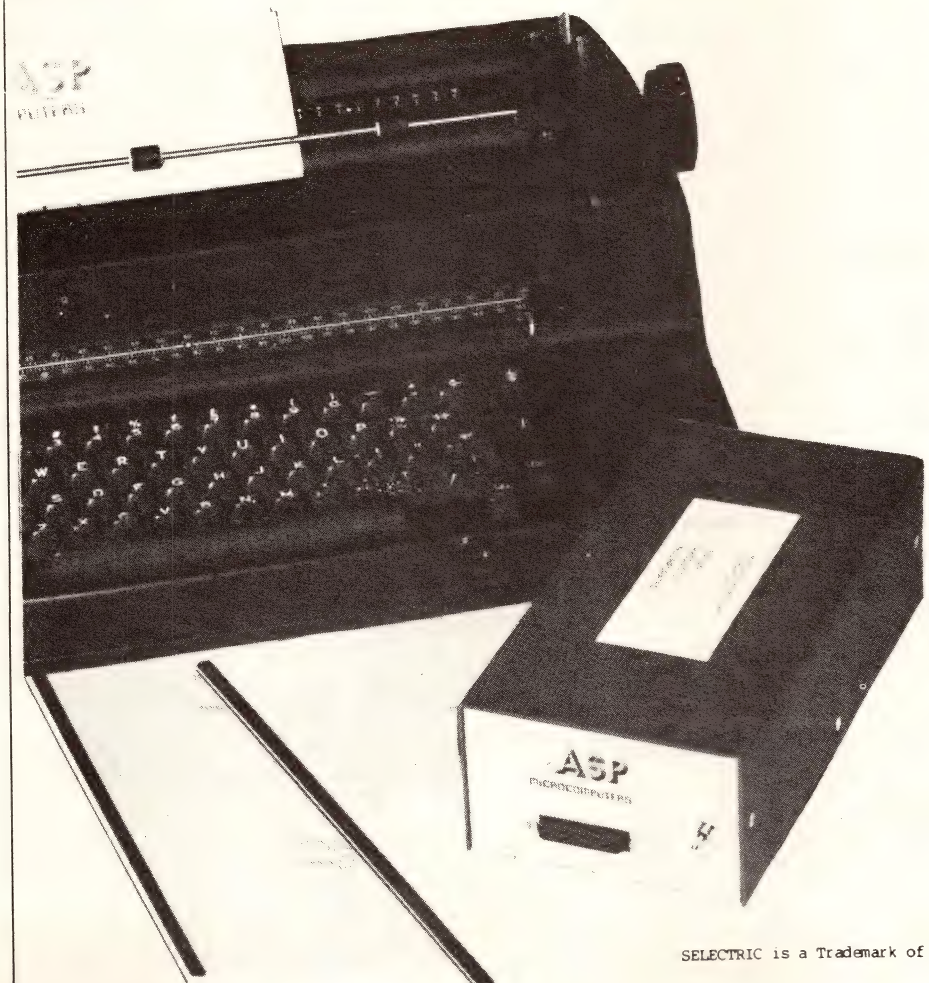

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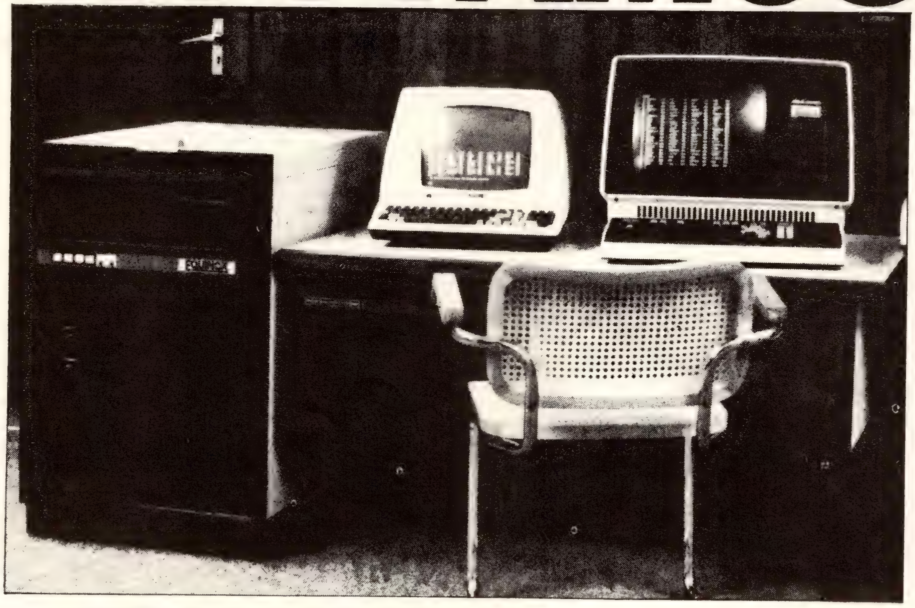

Sue Eisenbach and Chris Sadler bring you another system review in our multi-user Benchtest Series.

We were intrigued to be offered an opportunity to review an implementation of the MVT Famos operating system – billed as a system 'without peer in design and operating efficiency'; multi-tasking and multi-user with 'no significant degradation in response, even with several concurrent terminals'; and with a Basic compiler 'well suited to every conceivable application.' These seemed pretty strong claims which, if justified would go a long way to solving a lot of peoples' computing problems. Now read on.

Hardware

MVT Famos was supplied on an Industrial Micro System 8000. This machine is a Z80A S100 system with two 8in double density, single sided drives, 64k RAM and four serial ports. The documentation states that Famos requires disks, an 8080 (8085 or Z80) processor with a CP/M bootstrap in ROM, 32k RAM for Famos and 32k for each additional user. There are no inherent restrictions on the number of users which a Famos system can support although, in practical terms, the particular applications will determine both the degradation experienced and the acceptable upper limit.

Efficient disk access is essential as all the system functions and utilities are stored on the disk and normal operation engenders a great deal of traffic – hard disks, therefore, are a distinct advantage. All terminal communication with the operating system must occur in upper case so sanity demands either an upper case terminal or a terminal featuring a 'caps lock' or similar switch. (Anyone who thinks that a simple shift-lock will do has not counted the number of times that '.' or ',' or simple digits are required in normal programming.) The word processor Wordflow requires 'clear screen' and an addressable cursor and is most easily used if 'clear to end of line', 'clear to end of screen', 'delete line' and 'insert line' are implemented also.

The documentation claims that Famos uses a number of microprocessor facilities which are not exploited by other operating systems (all eight interrupt levels on the 8080, for instance), so that hardware which runs other systems quite happily may crash under Famos because some such facility has never been fully tested. The documentation further states that it is the user's responsibility to ensure the integrity and reliability of the hardware before using Famos. We take this to imply that Famos itself does very little automatic checking during operation, although there are a number of stand-alone diagnostics for checking both memory and disks.

The operation system

MVT Famos is a multi-tasking, multi-user operating system offering the usual four features, namely: dynamic allocation/scheduling; a filing system; a security system and command processing software. Despite its name, Famos bears no relation to IBM's operating system MVT. Scheduling is handled by an algorithm which allocates varying (interleaved) intervals of CPU access to queued tasks on a priority basis, there being 16 priority levels. Memory is allocated from a free-memory pool on a 'best fit' basis which works in conjunction with a fragment collection scheme. The operating system occupies 32 kbytes of memory, leaving a further 32 kbytes of addressable user memory, although bank-selection in 16 or 32 kbyte banks is supported. Incoming tasks are automatically assigned to the least busy bank.

All devices (ie, both I/O and mass-storage peripherals) are accessible through device drivers recognised by the file-system. Each mass storage device supports a single directory which records all the file names on the disk; file types (A for alphanumeric; B for Basic object files; C for machine code routines and E for Editor files); file sizes and file protection, which includes a password. Files can be protected from being opened, deleted, written-to, shared or having their names changed.

Security is via a password system which controls access at log-in and is also used to prefix user-files by placing certain automatic protection features on files so created. User names beginning with 'X' and file names beginning with 'C' are exempted from the security scheme – so users with a log-in name beginning with an 'X' (ie, system users) can access all files whereas ordinary users can access only their own files or those whose names begin with 'C'. Unfortunately, an ordinary user can gain the rights of a system user merely by prefixing a single ASCII character (specifically mentioned in the word-processing manual) to forbidden file names.

Fortunately, there is one further level of security. Utilities and file names can have individual passwords on them preventing use by anyone (including an 'X' user) who doesn't know the password. On the review system utilities such as SCRATCH (delete a file from the disk) had passwords. The implications of this are that the utilities are not available to users and all housekeeping is left to a system manager. The alternative (ie, making the utilities public in a single directory filing system) would only be contemplated by the naive.

The operating system can be built by a 'system generation' process during which details of the hardware configuration together with device drivers and such specifics as the numerical precision within the Basic run-time system (3-18 decimal places). The relevant machine code segments can be brought together either by the link editor or, more interactively, by means of a special Basic program. Most modifications to the configuration or general system organisation will require regeneration of the system.

The entire operating system appears to be the work of one George Pilipovich of MVT Microcomputer Systems whose article ('Multi-Tasking the 8080: Famos on Online System', *Interface Age*, February 1979) is recommended to readers who want more details. As a 'one-man show' the general feel of the system is that it seems to exhibit some idiosyncratic features which we hope to be able to illustrate in the following description of the command-line processor.

During log-in, a task is created called the 'Super Selector'. This is the (re-entrant) command-line interpreter and is the 'parent' on any other task the user initiates. Like its UNIX counterpart (the Shell), apart from its ability to spawn sub-tasks in this way, the Super Selector (SS) is not capable of initiating much processing in its own right. In fact, it will recognise only five commands which are in the Super Selector box. Unlike the UNIX shell, there appears to be no way to dispatch two or more simultaneous tasks from a single command line although it is possible to initiate sequences of commands on one line.

Apart from the user-defined tasks (ie user programs) there are a variety of system tasks available to the user under the Super Selector. These are divided into 'functions' and 'utilities', the distinction being that a utility will require the 'Q' command for its initiation (eg, Q VERIFY, to check that disk sectors are good), while a function name is directly recognisable by the Super Selector (eg, COMPILE). It would have made for a nicer user interface if the Super Selector had a way of separating the two types of programs so the user did not have to remember when to put 'Q' in front of a utility call. Seven 'function files' are required on the floppy-disk based system in order to provide the Super Selector with its power. On the review machine, the system utilities and functions effectively tied up one of the two available disk drives.

The system functions are described in Table 1. The system utilities comprise a set of programs largely of the 'system administration' type which provide facilities to inspect and test various features of the hardware (disks and memory) or system (files, User Accounting Blocks, etc). Most ominous among them is CFIX, a routine to clear the compiler queue should it become 'frozen'.

Batch operations are supported on the system by means of a 'batch jobfile'. This is a special file on the disk which contains commands to the Super Selector and information about tasks to be run, where the input is to come from and the output to go. This is queued to a specially-created 'batch monitor' which behaves as a 'virtual' user without the benefit of a terminal.

All in all, we found the system had an archaic (sixties) feel and was fairly awkward to use. Once a function is initiated, it always prompts for the file-names it requires, eg user types COMPFILE; system replies with ENTER SOURCE, OBJ, MESSAGE FILE NAMES. In fact, it is possible to enter these file names on the same line (the user invariably knows what files are expected so the prompt is not really necessary) by placing a full-stop between the command and its parameters, but the prompt appears anyway. Secondly, we found it a nuisance to have to create files in advance of using them – a more 'user-friendly' operating system would automatically create any files like object, message or source files. Thirdly, there are hardly any defaults or wildcards on the system, so that far more typing is required than on any other system we've seen. Finally, since the Basic run-time system is memory resident and too big to coexist in memory (on a single user 64k system) with the compiler, we found that the normal EDIT-COMPILE-RUN cycle, which one adopts during development, became something like:

CREATE source file
CREATE message file
CREATE-C object file
EDIT source file
COMPILE
  RUN
EDIT
COMPILE – crashes because there isn't enough room in memory
PROGRAMS – so see what is going on
RELEASE – to get Basic out of memory

CFIX – to clear the compiler queue cycle back to . Admittedly, this reflects the experience of new users but we've never run out of memory on any other machine (many with a lot less than 64k) when testing the Basic benchmarks.

Editors

There are two editors of the Famos system, the first a simple line-editor; the second a screen-oriented word-processing package called Wordflow.

The line-editor (invoked by the command EDIT), prompts with a '>' symbol, once the requisite file-name has DELT line number (delete line), EDIT line number (find and display line for editing), ENDE (terminate edit), LIST (list whole files) are recognised. Anything else must be an input line preceded by a four-digit (no more, no less) line number. Utilities exist, external to the editor, for removing, replacing or altering line-numbers. One rather surprising feature of the DELT command arises when the specified line number does not exist on the file. In this situation, instead of simply issuing an error or warning message, the editor will delete the next highest line – so any mis-keying could have some unpredictable and fairly disastrous results.

Once a line has been referenced for editing, control keys are used to position the cursor on the line and effect any editing as follows: CNTRL G – move cursor one character to right; CNTRL H – Move cursor one character to left; CNTRL I – insert one character to the left cursor (if more than one character needs to be inserted, then before the string is input, CNTRL I must be typed once for each character in the string); SPACE BAR – delete one character.

Once ENDE is typed, certain automatic housekeeping functions are performed on the file (basically, all the modifications are linked into the file) so that it is not immediately available for further processing. We thought that this seemed a fairly ordinary sort of line editor, much along the lines of the editing facilities to be found on most interpreted Basic systems.

MVT Wordflow is the word-processor package. It consists of a suite of programs which includes a screen-editor and various printing programs. The screen-editor can be used by any number of users simultaneously (ie it is 're-entrant'), but separate copies of the printer programs are required when more than one user wants to output.

(i) User Accounting Functions
  ACCOUNT – Displays cumulative account
  ADDUAB & DLUAB – used for creating and deleting a possible user
  PUAB – for printing out possible users
  PRESET-LOG & WRITE-LOG
(ii) Monitoring Functions
  BANKS – displays status of each memory bank
  CORE – displays free memory
  MAP – displays disk file directory
  PASSWORDS – displays file directly with password
  PROGRAMS – gives status of non-resident programs in memory
  TASKS – displays status of tasks owned by the terminal
  USERS – displays names of all users logged on
  LOC-TASK – like TASKS but for all users
(iii) Processing Functions
  CREATE & CREATE-C – for creating files
  COMPILE
  EDIT
  PRINTER – puts file in printer queue
  SCRATCH & SCRATCH-C – for deleting files
  RUN
(iv) Altering Functions
  CHANGE – change name (or password) of a file
  FREES – releases functions from memory
  LOADKP – loads and locks down programs in memory
  LODn – loads a specific function
  MERGE-M – merges files
  MOVE – move a file
  RELEASE – release a non-resident program
  SUPER-ZAP – used to end or suspend any task in the system
  TRMTYPE – for patching a specific terminal driver
  SETIME & TIME
  SEND – for interterminal messages

Table 1 Super Selector functions

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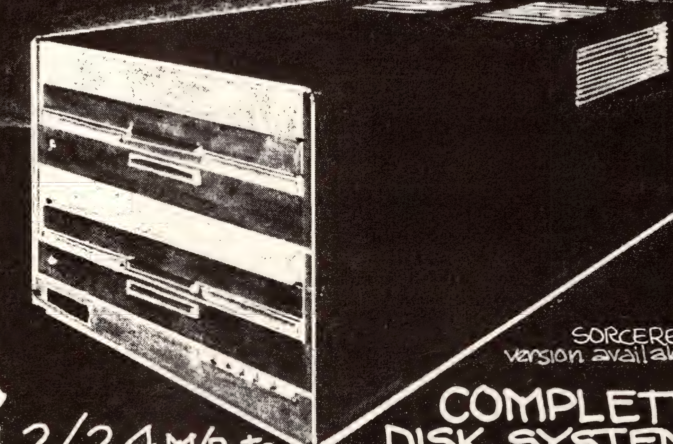

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The user has control over how much of a file can be in memory at any one time during editing – obviously for one user, the greatest convenience would be to have the whole file present, but clearly this isn't always possible in a busy multi-user environment. The manual recommends a 3-4 kbyte memory 'buffer'. There is also a buffer between the keyboard and the screen so that a typist can type ahead of the editor.

In non-edit mode, the editor can be used to move files to and from disks, create temporary files and define formatting details such as margin and paragraph spacings, etc. Standard formats can be saved on special files and invoked, where appropriate, during editing. Non-edit mode operates around a menu system and a 'help' command can be used to provide extensive guidance during operation. Edit mode allows both for text-input and for text-editing. Normal cursor-control, insertion and deletion (in units of characters, words, paragraphs or pages) facilities are provided, together with a number of more sophisticated features like printer control (eg, boldface, underlining, sub- and super-scripts) and 'customisation symbols'. Customisation symbols can be positioned in the text at places where information held on other files needs to be substituted at a later stage in the preparation of the document. Thus a file of customers' names or a list of prescribed pages can effectively be merged with the textfile. Headers and 'footers' can be attached to the top and bottom of each page output, and blocks of text can be moved about within the file – so the editorial tasks of 'cutting and pasting' are supported.

The printer programs are WD. DIABLO (for intelligent word-proccessing type printers) and WD. OUTPUT (for the simple pinters). Each features a menu which enables the user to set some of the formatting parameters and choose the number of copies required, etc.

We felt that Wordflow offered some fairly powerful facilities but was slightly clumsy to use – for instance, temporary backup files have to be created by the user (since they will always be required, the package ought to do this automatically). These files hold the modifications made to the actual file during the current and previous edits and a separate operation is required to merge the temporaries with the original – and this must be done before the temporary file gets too large. Sometimes we found that the text appearing on the screen wasn't quite what we had expected (or typed in), although these oddities seemed to disappear when the file was sent to the line-printer. Some of the functions required rather more keystrokes than would be strictly necessary (eg, delete character immediately before the cursor = ΛD ΛC), but one would expect these to be customised to the user's terminal in a word-processing environment anyway. Finally, character positioning across the line is done relative to the left-hand margin rather than the left-hand edge of the screen – so if the left-hand margin is set to ten spaces, say, and the right-hand margin set to 60, then the text will occupy character positions 10-70, rather than the 10-60 which typists would expect with that specification.

Basic

MVT-Basic offers most of the facilities one would expect in a 'large' micro-implementation of Basic, including system utilities especially for commercial programs. Multiple statements on a line are permitted, together with up to eight-character variable names. Strings have (by default) a length of 80 characters, although this may be increased (or decreased to save space) by means of the size command. The IF-THEN-ELSE construct is not supported.

Disk-files are available as serial access (via PRINT and INPUT), random access (via GET and PUT) and ISAM (via a set of machine language calls) files. ISAM, which stands for 'index sequential access method', is a sort of compromise between random and serial access files. Records are stored like random records but their locations are recorded in a series of index files which are sorted according to 'key' values within each record. Two sorting utilities (one for main memory, one for disk files) are available to help to keep the key files under control.

A full library of arithmetic, string-handling and formatting functions is available together with the ability to implement new library functions. Calling library routines and assembly language routines (8080 or Z80) may have parameters passed to them. Batch monitors may be initiated within a Basic program and a variety of file-handling and terminal output control routines are available on the same basis. These make Basic a powerful development system for the production of commercial programs, notwithstanding our reservations about the overall awkwardness of the operating system and our doubts about the wisdom of using Basic for commercial program development.

The compiler generates (line by line) pseudo-code object programs which may be submitted to one of three run-time systems – Basic (for 8080 machine code); BasicZ (for Z80 machine code) and Basic DBUG for debugging. This is a clever arrangement, since it allows for a certain amount of flexibility and tuning of the relevant run-time systems without committing the compiled objects to any given source program. However, as our benchmark results show, neither the arithmetic nor file-handling functions show the benefit of the extra efficiency of Z80 code.

The debugging run-time system allows the user to set and clear breakpoints, display the contents of variables and start the execution at any place in a program. The compiler produces a source listing with hex numbers before the Basic line numbers and a symbol table where each variable is given a hex value. It is these compiler-generated hex numbers, rather than the Basic line numbers and variable names, which the debugger references. It is a pity that the debugger designer requires the programmer rather than the debugger to remember these references. Debuggers are much easier to use when they refer to Basic variable names and line numbers.

One irritation we found was in the format of the individual Basic statement, where the line-number is represented in BCD (with a maximum of 9999), while the rest of the line is in ASCII. The line-editor can cope with this but Wordflow, the wordprocessor, requires special provision. Each BCD number must have a control character preceding it (a lesson we learned the hard way).

Benchmarks

We ran the single-user benchmarks under both run-time systems. The multi-user benchmarks were run in single-user mode on the floppy-based review machine (using both the 8080 and Z80 run-time systems). Rather than getting involved in discussions about how one would go about extrapolating these figures to cover all configurations, we shall present our timings without (much) comment. All times are in seconds.

We were at a loss to explain the performance of the hard-disk system on the terminal test in single-user mode (longer than with floppies) and on the Multiple Open disk access test with three and four users. We can only assume that since four terminals were always logged into this system (though inactive) while the single-user tests were being run, there is a certain system overhead in servicing the inactive users; also, the lock-out mechanism, which comes into play when more than one user tries to access the same file, works more efficiently when several users are queued for access.

Finally, the last table reflects the fraction of the single user time which is taken, per terminal, when running the multi-user tests. If this figure is greater than 1, it would be more efficient to run the jobs in sequence. As expected, the processor test shows some degradation in response. The others show a remarkably buoyant system (up to four users), especially the anomalous test 3.

Potential

Although not every type of multi-user application could be sensibly put onto a single Z80 processor, there are many applications which are not particularly processor-bound and where Famos, running on a suitable hardware configuration, might be satisfactory. However, we felt that the standard system software was a little too stilted and unhelpful to make for a really smooth development environment.

This type of tuning takes time and would require someone with a good working knowledge of assembly language programming. The ISAM file structure (which is not particularly well-handled in the manuals) is very useful for the production of its commercial software. All the file handling in Basic employs a lock-out system to prevent more than one user from accessing (or corrupting) the same record at the same time. Routines exist in assembler so that the system programmer can easily set up file-protection. However, it is unusual to find a commercial applications programmer capable of, or willing to, program more than a tiny bit of his work in assembler, and the

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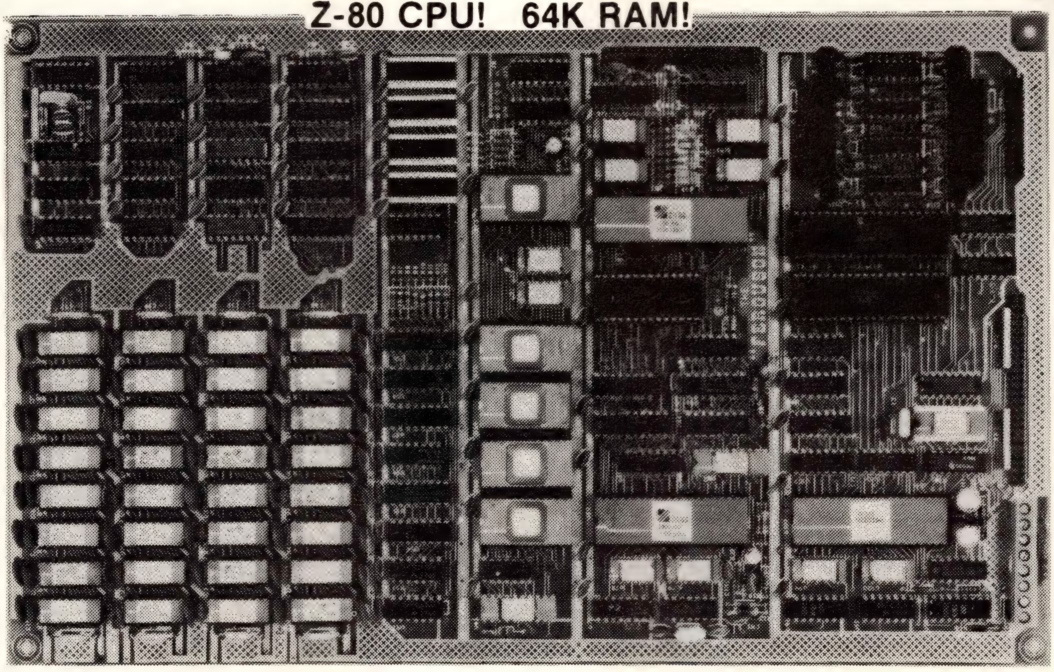

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only other language at present on the system is Basic, although apparently an arrangement has been made so that Pascal/Z may be implemented.

Turning to the educational market, we thought Famos would be a poor choice for a school system. Firstly, it lacks any graphical capabilities and has a very limited choice of programming languages. Secondly, and more importantly, it does not handle the new development user gently enough – this may not matter to the intelligent extrovert programmers in a class; it's the diffident plodders who risk being put off computing for life. Thirdly, the system requires a systems programmer and/or manager to set it up and perform constant housekeeping chores, and this individual is a luxury which few schools can afford. Finally, the system does not particularly recommend itself as a laboratory tool as there are no device drivers for data-logging equipment and suchlike, and the mathematical subroutine library (part of the operating system, and not of Basic) is too slow for much number-crunching.

A Famos system could be employed as a multi-station word-processing system – and it is used for this purpose by the US Navy. Wordflow, being menu-driven is reasonably powerful and easy to use, although it is not as easy to use as some others we have seen. In the multi-user context, however, Wordflow has the advantage of being re-entrant – so with only one copy of the program in memory and with a good spooling program to the printer, the system could be loaded up with quite a few typists without suffering severe response problems. However, for this sort of application, a hard-disk subsystem is a virtual necessity, since Wordflow employs a tiny memory-buffer for the text-file so the higher transfer rate offered by the hard-disks would be another vital factor in keeping the response buoyant.

Documention

The Famos documentation came in two large ring binders and comprised a user manual; a Basic programmer's guide; a Wordflow manual and a program development manual. Our overall impression was that these had been prepared with greater care than is usual in the micro-world. All were paginated, had a detailed table of contents and were well laid-out. In the programming sections, each instruction is given a full page which includes a definition of the instruction, an explanation of its function and a full example. At the end of the section, all the instructions are summarised with a one-line description. The style of the text is slightly patronising in tone (eg, 'It is absolutely essential that all of the General Consideration section be read carefully prior to the use of Famos') and is given to rather sweeping statements (eg, 'The system is designed to virtually preclude system crashes owing to user errors'). Nevertheless, the manuals seemed to provide a good overall introduction to the system, although there may have been room for a coherent description of the design philosophy and a bit more depth on the workings of certain features; particularly the filing system.

The one manual we didn't like was the Wordflow manual. This consisted of 165 pages of description supposedly aimed at the secretary. Every feature therefore is described in laborious detail with every option and possible outcome spelled out. The result is that it is page 62 before one finds out exactly how one goes about actually typing some text in. There is no real overview given and no short-cut. (In fact, the introduction states: 'It is extremely important that this manual be read sequentially and carefully.') Obviously, this sort of detail is necessary to enable the frequent 'professional' user to get acquainted with all the features and to become an expert, but both the beginner and the casual user need a simple set of instructions showing how to set up a standard sort of text-file and get it printed out.

Conclusion

MVT Famos is a multi-user operating system that runs on a single (8080 family) processor. We spoke to a dealer who sells several multi-user operating systems for 8080s and asked him why people chose Famos. His reply was that Famos stood up better to a large number of terminals than did the other operating systems available.

In its favour, Famos offers a high standard of documentation, nice utilities for file handling, three Basic run-time systems and a word processing package. Most of the software can be re-entrant although this sharing is dependent on the way the memory is divided up.

The major disadvantage of Famos is that it is an unfriendly operating system that requires the programmers and system managers to spend a significant percentage of their time doing housekeeping in the system. In this day of pricey programmers a software house could probably find that the overall cost of the packages they produced was lower on a more expensive configuration.

Timings

Single User	8080(Basic)	Z80(Basic)
BM1	1.4	1.1
BM2	3.4	2.5
BM3	7.3	5.7
BM4	16.1	14.2
BM5	17.1	14.8
BM6	25.5	21.7
BM7	30.5	25.8
BM8	81.2	81.2

Note BM8 tests arithmetic subroutine library.

Multi-User	Tests (One User)	8080 (floppies)	Z80 (floppies)	8080 (hard disk)
	Processor test	30.5	25.8	30.1
Test disk	Single Open	40.1	39.9	7.6
file access	Multiple Open	222.1	221.7	76.1
	Terminal Test	55.4	51.7	69.1

Multi-User (8080 with hard disk)	1 user	2 users	3 users	4 users
processor test	30.1	63.4	100.4	134.6
single open disk access	7.6	11.6	16.3	21.3
multiple open disk access	76.1	93.6	73.8	87.3
terminal test	69.1	99.7	143.1	185.7

Percentage of single user times

	Users	1	2	3	4
Tests	1	1	1.05	1.11	1.12
	2	1	0.75	0.71	0.70
	3	1	0.61	0.32	0.29
	4	1	0.91	0.87	0.85

Q =	queue – initiate named subtask. This will create the new entry in the appropriate tables and begin execution. For example, to see a file the program DISPLAY must be executed which is done by 'Q DISPLAY'. Control can be returned to the Super Selector by pressing the ESC key.
S =	suspend – stop execution of named task. This command is probably not used much since for most needs ESC performs the same function.
R =	resume – continue execution of previously suspended (by S or ESC) task. If the letter W is typed after the task-name, control of the terminal will be passed to the task; otherwise control remains with the current task.
E =	end – discontinue execution of named subtask and remove from memory.
O =	off – log out terminal

Table 2 Super Selector commands

LEISURE LINES

with J J Clessa

It's quite typical of the computer population in general, and the readership of APC in particular, that when a problem is given which they can't solve the reaction is not "I can't do it", but instead "It can't be done"!

What arrogance! Anyway it was very satisfying for me, after months of abuse about the problems being too easy, to find one that floored so many. Out of 20 replies only 1 had the correct solution which was $(\frac{41}{12})^2$. If you add 5 to this you get $(\frac{49}{12})^2$ and if you subtract 5 from it you get $(\frac{31}{12})^2$. All of which are perfect squares — obviously the majority of readers assumed that perfect squares implied an integer value.

Anyway, it was easier to pick the winner this month — none of Howard's random number nonsense — and the lucky man is Mr R. Blomberg of Wantirna Sth. If that didn't brighten your day Mr Blomberg I'm sure the prize will — 25 lightbulbs are on their way!

QUICKIE

An old chestnut: If a brick weighs 7 lbs plus half a brick, what is the weight of a brick-and-a-half? Sorry, as usual no answers, no prizes.

PRIZE PUZZLE

A man goes into a supermarket and purchases four items. Before he goes to the checkout he decides to work out the cost using his new pocket calculator. However, he is neither very numerate nor very adept in the use of a calculator. By mistake he hits the X key instead of the + key for each transaction. The result he arrives at is $7.11, and, when he arrives at the checkout, the assistant adds up the items in the normal way and gets the result $7.11. The man is satisfied and pays, never knowing the stupid blunder he'd made. What was the cost of each item involved?

Answer please on a *postcard* (all letters go in the bin): Puzzle No 12, APC, Box 115, Carlton, Vic. 3053.

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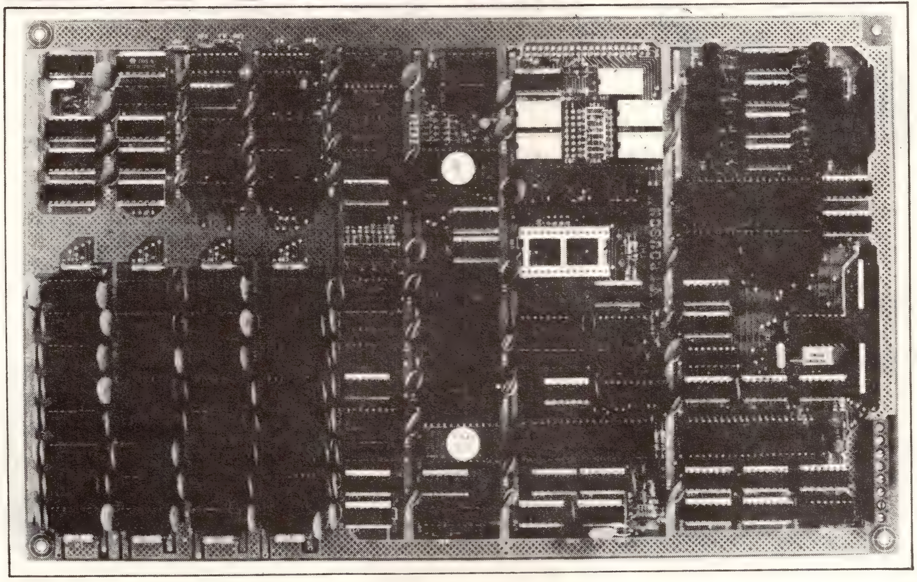

Dr Neil Cryer tests this single board computer.

The name Bigboard reflects the facilities offered by this single board computer, rather than its size. At only 8½ x 13¾ in., it is small enough to fit into a large keyboard case, which was how I first saw it in November, 1980.

At the moment, it is available only as a kit and is advertised as being suitable for people with some hardware/software experience. It comes without the necessary ancilliaries of an ASCII keyboard, a power supply and a video monitor, and with no floppy disks. For review purposes, however, the suppliers, Ritronics Wholesale, provided a ready constructed board, tested to the minimum configuration advertised.

Facilities

Bigboard comes with a floppy disk controller, and gives a full 64k of RAM. Ritronics says that it will eventually be available made up and in a case as a complete system.

The minimum configuration has no spare ports; the existing two drive the floppy disk system and the ASCII keyboard. Extra kits are available – one supplies an extra PIO giving two spare 8-bit ports, and another is available for adding two serial ports with software programmable baud rates (50 x 19.2 kbaud), while a third provides a counter timer chip to give a real time clock, together with floppy disk shut down after any 30 second period of inactivity. No further expansion is intended, which some users may find limiting.

I see Bigboard as providing the heart of a system comparable with SuperBrain.

Construction

The instructions in the construction manual are clear, concise and adequate for the manufacturer's target customers experienced with hardware and software. Other users might find them too brief, as there is no advice on such things as identifying resistors and soldering.

To put myself in the position of someone making up the kit, I asked the agents to supply me with the components for the serial port so that I could see how easy it was to construct using the instructions. I consequently fitted six ICs, a crystal and 20 sundry other components. There were no problems. The component positions were marked on the board in the usual way and the soldering was no finer than with most other computer boards.

As with any kit of this type, there is little documented help for anyone unlucky enough to have a system which doesn't work first time. The instructions do offer a few suggestions as to the areas of the circuit which may be responsible for certain faults, but essentially the user would have to be experienced enough to trace through the circuit using suitable equipment, Ritronics does, however, promise a full back-up service.

Installing the system

The system will operate without floppy disk drives, but since I imagined that most people would be buying it largely because of the controller, I wanted to incorporate this. So I connected two 8in. Shugart SA800 units.

The video section provides a 60Hz frame signal for a monitor which gave no problems. I would not advise anyone to fit their own modulator for running this board on a normal television because any display of 80 characters per line is generally unreadable on a normal television.

Memory arrangements

Bigboard has a full 64k of usable RAM plus 2k of video RAM, plus up to 8k of EPROM type 2516. The video RAM and EPROM are addressed at the cost of temporarily switching out some of the 64k main RAM. Bigboard switches between alternative memory blocks by addressing an appropriate output port location.

On power up, Bigboard switches out the first 16k of RAM and makes the 8k block EPROM available instead. It starts by executing the monitor program in this EPROM at address zero. The first instruction is the Z80 block mover which relocates the monitor to the top of RAM. Bigboard then makes a simple jump to the new copy of the monitor in RAM which then switches the bottom block of RAM back into use. Pressing the reset button does the same trick. 6k of EPROM are not used at the moment and so are free for user programs. The memory-mapped video display similarly block switches be-

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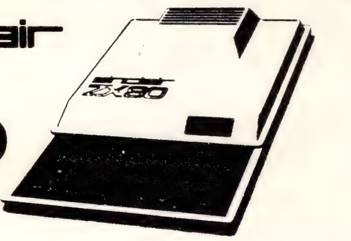

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tween video and normal RAM. For the rest of the time, the whole of RAM is available for use in whatever way the user wishes. This contrasts with systems where some of the memory addresses are taken up permanently with EPROM.

Bigboard's ports, in common with all Z80 systems, are addressed by separate IN and OUT commands and don't take up memory locations. Its port addresses are used not only for the usual input and output from the board, but also to control the baud rate of the serial ports, scrolling for the video, and block switching of the memory as described above.

The character set

Like many systems giving 24 lines of 80 characters, Bigboard's characters are formed using a 5 x 7 dot matrix. Due to their small size, display on a converted TV used as a monitor is rather poor. In the first model, the lower case characters were just a small version of the upper case letters, but recently a new character set has been added giving a true lower case with lower descenders.

The Bigboard has no graphics capabilities, which may be a drawback. Though CP/M software does not allow for graphics, the character generator is a 2716 EPROM, so specialized character sets are a possibility.

The system commands

Bigboard powers up to display the message '. . . system 3.3 . . .', followed on the next line with an asterisk and a dash as a non-flashing cursor. Eleven single letter commands are available before CP/M is called up; in particular, D to display the contents of a block of memory; M to display the contents of successive individual memory locations to allow them to be changed; R to read a sector from disk into memory; F to fill a block of memory with a constant; C to copy a block of memory; and of course B to boot in CP/M; the command T, is useful because it displays the exact location of any bad memory.

A full list of the jump table is supplied; it explains what the various subroutines do and what parameters they expect.

Bigboard requires all commands with numbers to be typed in with only commas as separators and with no extra spaces anywhere. This is simple to get used to, but might be a little annoying at first to anyone used to a freer format.

I see purchasers adding other commands to the monitor program which, at present, makes no use of the scroll and cursor movement facilities, available as subroutines. I think it's a pity that Bigboard doesn't come with these; it would seem a relatively simple matter to provide full cursor control and on-screen editing, which would make such a difference.

Keyboard

Any keyboard should be suitable, provided it supplies the ASCII codes directly along seven wires (bits 0 to 6) together with a strobe signal going high or low when the data is ready. The strobe line prevents there being significant problems with contact bounce. All power supply lines are available on Bigboard's keyboard connector.

Floppy disks

Bigboard uses the 1771 controller chip and can drive up to four SA800 or similar disk drives. Connections are standard. It powered up without trouble and, on typing B for boot, came up with the message '60k CP/M version 2.2'.

With the use of CP/M, a wide range of software should be available for purchase, although any with specialised screen displays may have to be modified. As it is too early for any commercial software to be advertised for Bigboard, and as the review board was supplied with no software other than CP/M 2.2, I borrowed a copy of Basic from another CP/M system. I found no problems running it.

I checked a large number of the disk copy, verify and editing commands without any problems.

Video

The video is memory-mapped in a 2k section which Bigboard block switches; it is therefore independent of the main RAM at the same address, 3000H.

When the screen is written to, it fills from the top down and, when it is full, the display moves up each time a new line is entered. The screen may also be scrolled up or down by writing to an appropriate port, in which case any lines moving off the top will reappear on the bottom and vice versa. I see few occasions for using this facility.

Writing to the screen is by means of a subroutine in the monitor and occurs at the current cursor position which may be moved up/down, left/right. The user could also block switch in the video RAM and write direct to it, but the method of scrolling the screen would have to be taken into account which would make the programming trickier.

Expandability

Bigboard has been designed to be complete in itself, and no external bus connector of any sort is provided. The system should be used within the facilities offered, and should not rely on later expansion, as this may not be simple or indeed possible.

Documention

Bigboard is supplied with an 11 sheet construction manual, a seven sheet user manual, a seven sheet theory of operation manual and very clear circuit diagrams. The manuals are rather brief, but are in accordance with Bigboard, being for people with some expertise.

The future

The board at present only runs at 2.5 mHz and is only capable of single density disk control. Apparently a new board is being developed which will have 4 MHz operation and double density disk handling, though no information is available yet.

At a glance

Bigboard has some very attractive features, in particular the incorporated floppy disk controller and the full 64k RAM.

In summary, Bigboard's ports could drive a printer, a modem, a serial terminal and an ASCII keyboard and still have one 8-bit port spare. As no software is supplied to run the system, the user would have to write it himself.

With Bigboard, a system of video monitor, keyboard, 8in. floppy disk CP/M and power supplies can be put together for less than $700 which is certainly not unreasonable.

Overall I consider Bigboard to offer good value for money. I found it easy to set up and use and I suspect that for those with some experience it would be fairly straightforward to build from a kit. The lack of a bus arrangement limits expansion considerably but then you do get quite a system for your money. The ability to use CP/M makes an enormous number of packages available to the user and that, coupled with the 64k memory, must be one of the strongest points in Bigboard's favour.

Technical data

CPU:	Z80 2.5 MHz
Memory:	64k dynamic RAM +8k EPROM type 2516 (Only the 2k system monitor supplied) +2k video RAM
Bus:	Not available
Ports:	2 serial, 2 parallel uncommitted + ASCII keyboard port
System: S/W:	Monitor with 11 commands, CP/M

OPTIONAL ANCILLIARIES

For full potential an 8M Shugart SA power supply is needed.
+2k video RAM

800 compatible disk drive and associated power supply.

NECESSARY ANCILLIARIES

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The following commands are just a sample:

EDIT xx[,yy]
This allows you to edit your program just as if you were using the Wordprocessor Pac. All the same numeric keypad commands are used. You may even have Basic program lines over 500 characters long!

AUTO [xx[,yy]]
While entering program lines, each new line number is typed for you! All the EDIT commands are available in this mode, which greatly speeds program writing.

REN [a[,b[,c[,d]]]]
You may renumber all or a section of your program with one simple command.

TRACE [xx[,anything]]
This command runs your program and prints each line number on the screen after it is executed. You may optionally print values of numeric or string variables after each line number.

HELP xx
How many times have you got a 'SN ERROR IN LINE xx' message but could not see the error? This command prints the program line in EDIT mode and places the cursor over what System 3 thinks is the error! This command is especially useful with your now very long program lines.

FIND["] anything
Find and list all program lines containing 'anything'. An optional wildcard character may be included.

DEF x
You may define function keys with this sophisticated routine, which even includes an input feature.

VAR
List all variables and their values. This is often used after a program run.

LIST [xx][,[yy]
List all program lines from xx to yy.

DEL [xx][,[yy)
Delete all program lines from xx to yy.

CLOSE
Erase all spaces in your program excepting those within quote marks and in REM statements.

OLD
Recover a lost program after NEW, CLOAD or RESET

CLOAD?
Verify a program on tape without the possibility of contaminating memory in the case of a TAPE ERROR.

MERGE
Merge the incomming BASIC program off tape to the end of the Basic program in memory.

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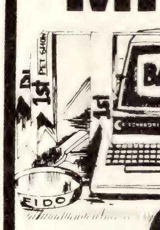

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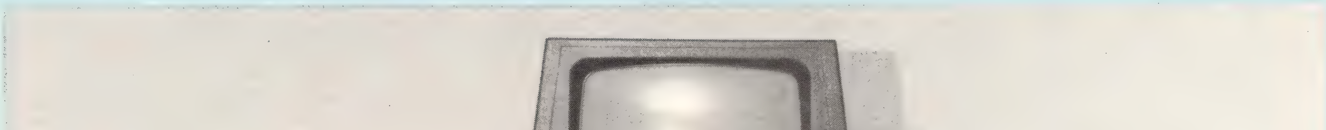

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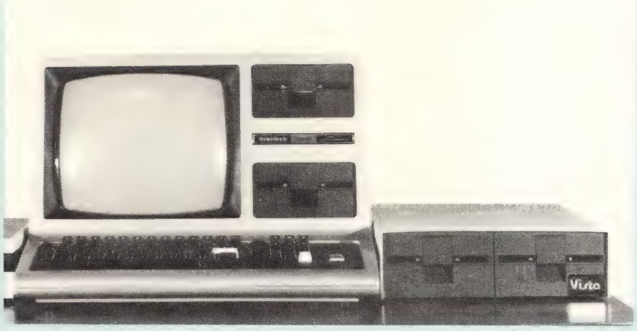

Vista Unit shown with Model III TRS-80.

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PERSONAL OPINION

by Bob Pascoe

Again, the expansion of the field we loosely call "computing" amazes me. My wife has just finished re-reading Aldous Huxley's famous novel *Brave New World,* written half a century ago. I read the book as a university student about fifteen years ago. At about the same time I also read George Orwell's prophetic novel *1984*, again about bureaucratic regimentation by government. In retrospect, what struck me about both novels was the repression, regimentation and control exerted by the fictional regimes, and how the control was achieved with huge clerical effort and no computerized assistance. Anne and I discussed how much more effective those same regimes could have been with the sort of electronic information which is now technologically commonplace.

Both novels failed (understandably) to accurately predict the emergence of computing as we know it. In a much more contemporary novel with a similar theme, Ira Levin presented the story of a world society dominated and controlled with computer assistance (*This Perfect Day).* I really enjoyed this one, not only because of the reasonably feasible description of minute by minute surveillance of *all* citizens, but also because the members of the ruling echelon were all programmers (well, we all want our turn – I only want world domination for a few months – sort of try it out!)

Computers have an enormous potential for good or bad – the advent of the microprocessor can have a social effect far beyond its obvious impact in personal computing. Either to sustain the totalitarian society of *This Perfect Day,* or for facilitating genuine democracy. Every person with secure access to their household electronic ballot box – a national tally on significant issues electronically collated in ten minutes! Mind you, it wouldn't be tolerable for a national vote to oust government immediately – in that case I suspect we would change leaders more often than I change my socks!

Governments do sometimes need to take a longer term view than their electorate may wish. But at least we wouldn't have some official talking about "all the right-thinking people of Australia" who (he knows) are on his side! Perhaps we could each vote for "our party" once a week, and the party with the highest tally after six years wins – no more pre-election promises, forgotten as soon as leadership is secure! Dreams, dreams.

It has been said elsewhere that those who understand programming in these times are as privileged as the learned men of medieval times who could read. Perhaps so, perhaps not. But certainly computing is challenging some of the traditional sanctums of society's "who's who". While we tend to think of computers as a threat to production line and clerical tasks, computer programs also have shown themselves to be better diagnosticians than most doctors, while the finding of the right case to establish precedent – an important function of lawyers – is easily within the "data sifting" ability of other programs. And, as you may have read in APC recently, programs are starting to challenge the skills of programmers at their own game. Computers may well end up being better economic and political managers than the economists and politicians – programs haven't yet proved themselves in this area, but then neither have their opponents!

But hold on! *Who* is deciding where computers *should* be used successfully, rather than where they *can* be used successfully. Not government! Perhaps the marketplace? Use them wherever profit can be made? Perhaps the computer scientists themselves – certainly an organization like the Australian Computer Society is trying to establish a philanthropic code of ethics. But could this be made binding?

I look forward with a certain degree of interest to following the future achievements of the Computer Science fraternity to which I claim membership. I would very much like to know whether in twenty years I will still be interested, or whether I will be damn scared.

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GATEWAYS TO LOGIC

Chapter 5 part 2: Electronic logic

Derrick Daines continues his series on teaching microcomputing to others

Gates and logic

Having given our students a taste of the practicalities, we can now demonstrate their use in principle. It's wisest to start off by presenting this work in the form of a few simple problems.

Example 1. If a boy steals money or smacks a girl and makes her cry, then he will be punished (Figure 20). Having demonstrated this on the blackboard, the children can try their hand at the next.

Example 2. Mum will fetch the baby in from the garden if it starts to rain, if the baby cries, or if mum has to go to the shops. In any case, she will fetch him in if it's 12 o'clock and she has his dinner ready (Figures 21 and 22).

Example 3. A Ruritanian passport will be granted to those people who have at least one Ruritanian parent, or whose father's parents were Ruritanian. In no case will a passport be granted to those who have lived for any length of time in Agrophobia, Ruritania's deadliest enemy (Figure 23).

Many other problems of this type will be found in abundance on any government form or any insurance policy! At the teacher's discretion such problems may be presented solely as above — or else students may also be provided with the gate outline drawing and be required to fill in the details. The more advanced may be given problems couched in Boolean — for instance to decide on the gate configuration that will produce a certain Boolean output. Alternatively, they can simply work through a given gate configuration (Figure 24).

Bistables and clocks

I have repeatedly said that a computer is nothing but a bunch of gates but now I must qualify this as being only 95 per cent true. Chief amongst the remaining five per cent are register memories and clocks.

The very earliest computers used a type of memory called a bistable (Figure 25). Now, although modern computers use a wholly different technique (and even better ones are still being researched), the bistable offers an extremely good way of demonstrating computer memory — in particular, the type of short-term memory that's still in use inside the microprocessor. What's more, it's extremely easy to assemble.

When the circuit of Figure 25 is wired up and power is applied, one LED will light up while the other remains unlit. Label one of them as output — it doesn't matter which. If you like, the other can be masked with a bit of paper. Now, taking the wander lead shown, touch in turn the bases of the two transistors; the condition of the two lamps changes — that is, the one that was off will come on, and vice versa. What's more, the two lamps will remain as they are, however long we leave them. The circuit is therefore totally stable in either condition — hence its name, bistable.

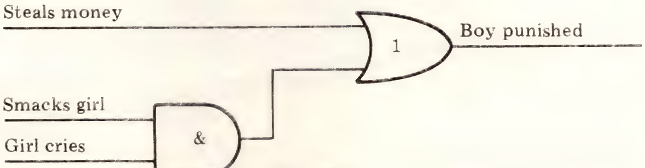


Fig 20

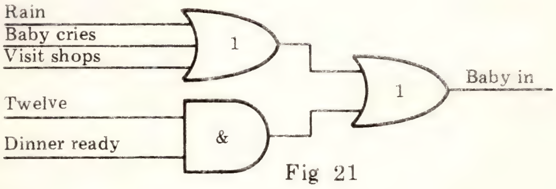


Fig 21

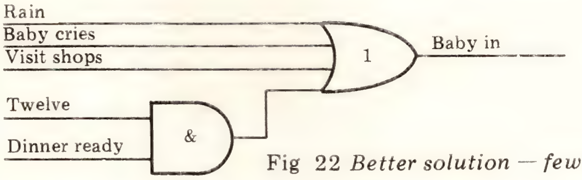
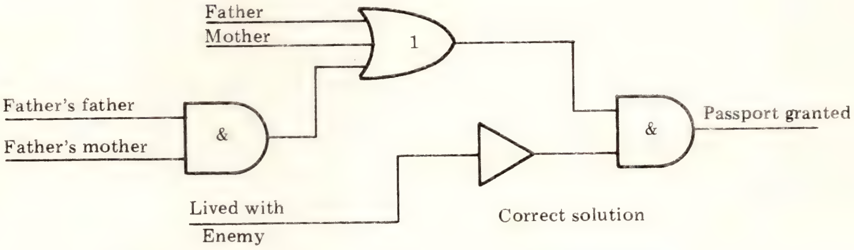


Fig 22 *Better solution — fewer gates*



Correct solution

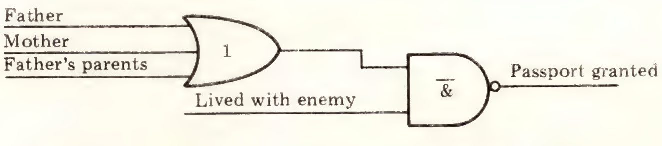


Fig 23 *Can you spot two errors in the logic of this solution? The answer is given at the end of this month's chapter.*

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Until recently, to realise the power of the Sorcerer you required an S100 Expansion Unit plus floppy disk drive and controller at a total of $1,724. Now Exidy's direct plug-in drive system gives a $1,190 alternative. That's for one drive, an extra drive adds around $600!

There had to be a cheaper method of high speed storage.

So we took our STRINGY FLOPPY (you've probably seen ads for the Tandy TRS-80 version) and produced a special version for the Sorcerer

STRINGY FLOPPY

STRINGY FLOPPY is a high speed digital tape transport system for storing programs and data entirely under the control of the computer. There are no controls to adjust, just one light indicating the drive is in operation and another indicating that data is being written onto wafer. Drives are individually packaged and connected to the Controller via a narrow ribbon cable.

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There is no need for rewind capability. Fast forward is implemented where appropriate to speed throughput.

Simplicity means reliability.

RECORDING SPEED DENSITY

STRINGY FLOPPY records at 8500 baud (850 characters per second). 28 times faster than the Sorcerer's lower tape rate, 7 times faster than its higher tape rate. On a 23 metre Wafer you can fit approximately 75K.

CONTROLLER

The compact STRINGY FLOPPY Controller plugs directly into the 50 way connector on the back of the Sorcerer. The Controller will handle one or two STRINGY FLOPPY Drives. Power to the Controller is provided by a plug pack. STRINGY FLOPPY Drives draw their power from the Controller. In operation the Controller turns off the Sorcerer's random access memory between 46K and 48K to accomodate a 2K read only memory (ROM) in the Controller. This ROM contains firmware routines to integrate the Sorcerer to the STRINGY FLOPPY.

MONITOR

Also included with STRINGY FLOPPY are two further ROM's to replace the Monitor program in the Sorcerer. Known bugs in the Monitor are corrected and routines included to allow computer input/output to be directed to tape or STRINGY FLOPPY using the SET Command. If STRINGY FLOPPY is plugged in at power up I/O is set initially to STRINGY FLOPPY. Others sell Monitors without the original bugs for round $100. Ours is included in the price of STRINGY FLOPPY.

MONITOR/BASIC

STRINGY FLOPPY may be used from either the Monitor or Basic. Wafers may be certified, programs saved or loaded. Up to 127 files may be stored on a Wafer (subject to capacity).

WORD PROCESSOR PAC

As in the case of the disk systems used with the Sorcerer, a patch program must be loaded from STRINGY FLOPPY to assign Exidy's Word Processor Pac input/output to STRINGY FLOPPY. This takes only a few seconds. The patch program is $50, approximately half the cost of the disk patch program. Remember to order it if you use the Pac with your Sorcerer.

PRICE

To be quite honest we couldn't do it for the price of the Tandy version. After all you get a replacement Monitor correcting known bugs, implementation of the fast forward capability of the Drive, a separate Controller design allowing relatively low cost addition of a second Drive, and higher data density. So although the initial cost may be higher, the cost of a two Drive system is substantially lower.

Remembering that we include a supply of 10 Wafers, STRINGY FLOPPY for Sorcerer is still under one third the price of Exidy's plug-in disk system, at $395 including Sales Tax. And the extra Drive is $175. If you order as a two Drive system at $570 we'll include an extra 5 Wafers on us. Add $5 for freight within Australia.

Extra Wafers are $3.50 each for any length except 23 metres which are $4.50 each. Allow $1 per box of 10 for postage within Australia.

A six month limited warranty applies to Drives and Controller and you will receive a year's subscription to our Stringy Floppy Newsletter.

If you'd like us to fit the Monitor ROM's for you we charge $10 and offer same day turnaround by prior arrangement. Alternatively our detailed instructions will guide you through doing your own fitting.

AND if you are not satisfied with STRINGY FLOPPY return it within two weeks in original condition for a courteous refund (this applies only to non-Bankcard purchases).

BANKCARD orders must quote full Bankcard number, Expiry Date and be signed.

Versions for other computers are available.

Note: Sorcerer and Word Processor Pac are products of Exidy. Disk prices from Dick Smith 1981-1982 Catalogue.

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And here we have a unit of memory. If the output lamp is lit, we can say that it represents a binary '1', while if it is unlit, then of course it represents a binary '0'. This is a very important concept for students to grasp. Computer memory is a term that will not, of itself, convey very much to them, and the uninitiated have some very weird and wonderful ideas about how computers remember anything. Try asking them! They'll doubtless be astonished to learn that computer memory is simply the difference between high and low-voltage states

In the average home computer, eight such bistables are (or were) needed for each and every computer word — either in the processing unit or in memory; students should begin to appreciate why the bulk of the early computers loomed so large, why they produced so much heat (two valves instead of transistors per binary bit) and why they spent so much time under repair.

It's very important to demonstrate at least one transistorised bistable. Figure 26 is very easily adapted from Figure 25; it simply arranges for the output of the first transistor to change the state of the second, which changes the state of the first, which changes the state. . . The values of the capacitors as well as some of the resistors can be changed within quite wide limits, to affect the rate of oscillation. At the slowest rate, oscillation cycles may take minutes, while at the faster rates the lamps barely seem to flicker.

Technically, the circuit is termed an astable, meaning simply 'not stable', but in computer circles it's universally known as a clock. The clock (or clocks — there can be several) is vital to the computer for it triggers events round the circuitry. For accuracy it often includes a crystal but in our case this is not necessary as the demonstration model which works very much slower. Sometimes it's convenient to use both halves of the clock for triggering different events — it all depends upon the design or architecture of the computer.

I find children, in particular are fascinated by the clock circuit (and there's no reason why it should not be run for hours at a time — battery drain is very light). And not only is it a great attention grabber — there are hundreds of applications where such a handy little circuit will come in useful.

Computer control

We now have all the building bricks of the computer and can therefore begin to put them together to evolve the finished product. No new devices are to be considered in this section; just new or improved ways of utilising those the students have already been shown. There's at least one kit on the market that's designed to teach how a computer is constructed and controlled and no doubt others are on the way; indeed, readers may like to assess their value after reading this section. For some it could be that what is written here will be considered sufficient; other readers (perhaps those with a slightly more specialised interest) will consider the learning experiences offered by such a kit to be well worth the rather heavy outlay.

Figure 27 is part of a hypothetical computer and it adequately illustrates how the earliest of them were controlled. Personally, I've always found a blackboard illustration sufficient — see also Figure 28. Figure 27 shows the basic principle in detail. The data lines run all over the computer, carrying information here, there and everywhere; they may be likened to railway tracks, the gates representing the track points. Inevitably, numerous loops are formed and the clock is necessary so as to keep all the operations in step with one another — rather like a number of trains running on the same railway line loop but without collisions.

Examination of Figure 27 will show that data cannot flow anywhere unless the manual switches are closed — because the AND gates require that all inputs should be high. If switch 1 is closed and data is present, then each time the clock pulses high, one bit of information is passed through the first gate. This is fairly straightforward and nearly all students grasp the idea very quickly, provided the previous work has been carefully covered.

The analogy of the model railway is very apt, for the very earliest computers were entirely controlled by manual switches — indeed the writer built one himself. Of necessity the control panel looked much like the plan of a marshalling yard — something along the lines of Figure 28. A and B are the two temporary registers that we've already met in connection with the cardboard computer, while C to F are long-term memories; each have eight little boxes, each of these representing a bistable memory element of the type just discussed and

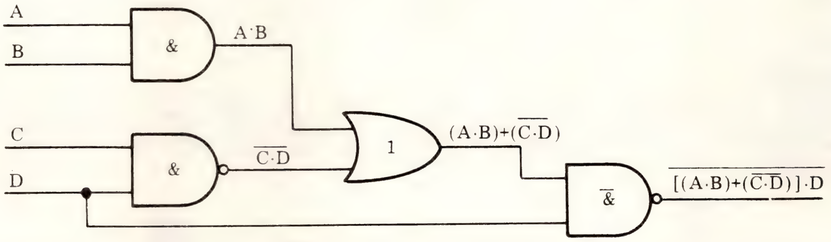
A
B
&
A·B
C
D
&
$\overline{C \cdot D}$
1
$(A \cdot B)+(\overline{C \cdot D})$
&
$\overline{[(A \cdot B)+(\overline{C \cdot D})] \cdot D}$

Fig 24

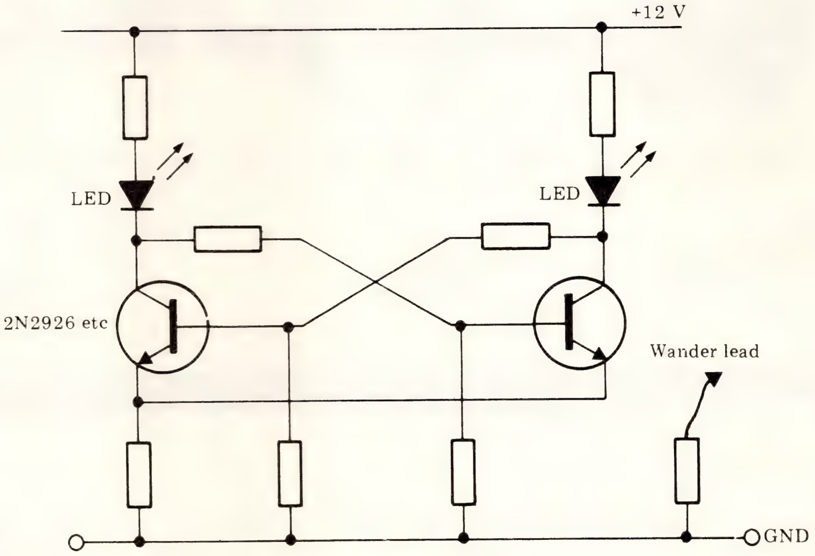

Fig 25 Bistable

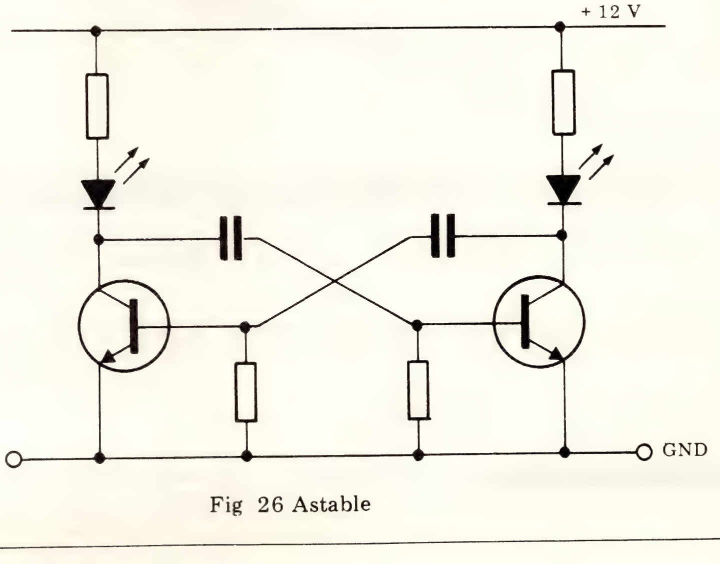

Fig 26 Astable

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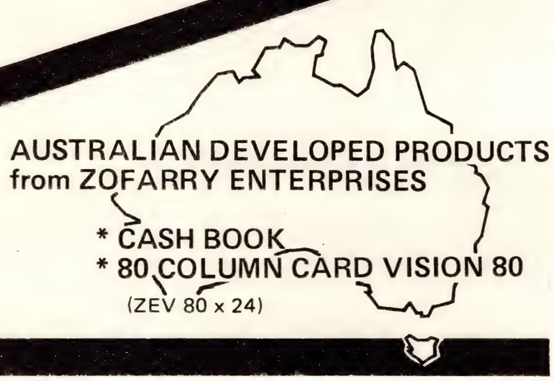

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arranged in a linear fashion as shown. The interconnecting lines are data lines only, the clock and control lines having been omitted for the sake of clarity. AND gates are placed at every junction and each one is fed with synchronous clock pulses. They are numbered 1 — 12 and it's assumed that each one has a manually-operated switch for control, as in the previous diagram.

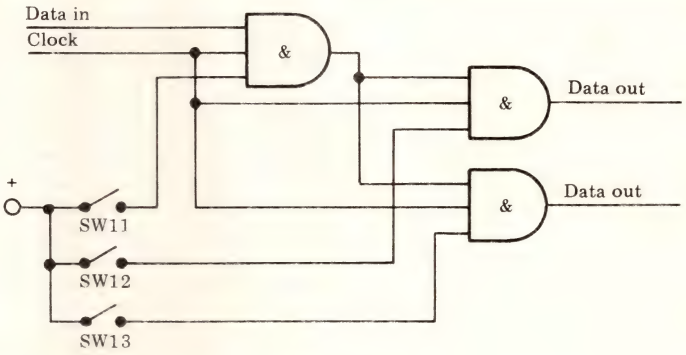

Fig 27

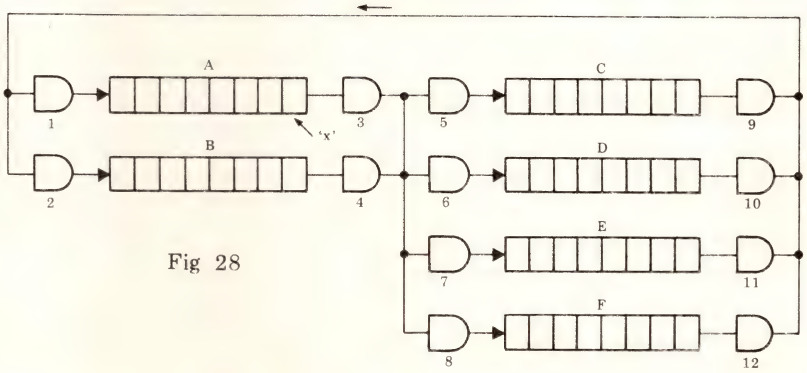

Fig 28

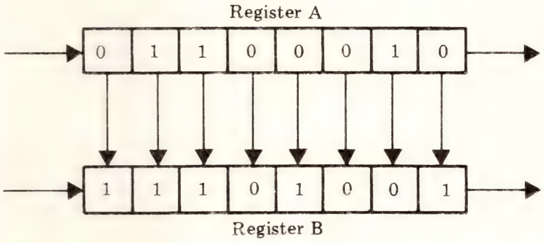

Fig 29 *Simplified parallel-shift (compare with Figure 28). One clock pulse will transfer entire register A, deleting contents of Register B.*

When explaining the diagram, we must also be careful to stress something that is not there — rather like the hole in the mint. The important thing to notice is that there are no memory elements other than those shown; no little resting-places for data exist along the main lines. . . they are for transfer only.

If we wish to store the contents of Register A in memory store C, then we must switch on gates 3 and 5 and ensure that all other gates are switched off. A train of pulses is applied from the clock and the data is transferred. Similarly, if we now wish to transfer data from store F to register B, we must switch off gates 3 and 5 before opening gates 12 and 2. In practice, operation of those earlier computers was a trifle more complicated than that and, for obvious reasons, laying out the control panel as shown in the Figure was the only way to minimise human error.

Students will have fun with the diagram if they are given starting and finishing conditions — eg, put the contents of A into C; C into B and B into A. This sort of problem allows us to made a few teaching points — especially if we stay with the analogy of the model railway.

Firstly, there is the question of one computer word (or train in our analogy) running into the back of another. Suppose for example we were to transfer a word into Register B where there is a word already — what happens to it? If it were a train, the result would be a mangled mess. . . a combination of the old and the new; in electronics however, the first is simply lost or erased as in the cardboard model. (I don't like the word 'overlaid' because in some minds that's analogous to the mangled mess.) The next question is, suppose we open gate 3 but forget to open any of the gates 5 — 8, what happens to the data shunted out of Register A? This is the reason we should have stressed the absence of any memory resting places other than those shown. In such circumstances, the data is again simply lost.

If they have not asked already, some students will now enquire how the computer knows that the whole word has been shifted. To put the point another way, when the leading bit of the word — or engine of the train — reaches point 'x' marked in Figure 28, why does it not continue blithely on and, as it were, 'crash' into the buffers or the closed gate 3? Well, it would but for a little device known as a counter. This gadget counts the clock pulses — analogous to counting wagons on a train — and when it has counted 8, it simply shuts off the clock. It's not necessary to model this very simple action and students generally accept it readily.

Combinations of gates under automatic and/or manual control can be strung together so as to provide parallel shift (as it is termed); that is, of course, very much faster than the serial shift of Figure 28, but there is no need to stress the point for general students. Figure 29 illustrates the idea. Another combination of gates provides the adding or arithmetic circuit, while yet another gives comparison between two computer words. While they are, of course, enormously important to computer control study, generally speaking they are not necessary for the average student who is merely seeking background information. Such circuits are of necessity rather complex and therefore intimidating. Interested readers are referred to the literature.

A computer controlled by manually-operated switches in the manner described suffers from two major defects: (1) it's very slow and (2) it has no stored program. The slowness is due entirely to the human operator. It can take a considerable time to set a series of switches — a process that's also extremely prone to error. Once the GO button has been pressed, however, the machine is able to clock off eight pulses in a fraction of a second, so operation comprises an endless series of switch pushing, with constant reference to a series of written instructions. It's the absence of a stored program, however, that classifies the machine as a crude calculator and not a crude computer.

Stored programs

The concept of the stored program goes back a very long way and one of the earliest contenders for the honour of original inventor is one Joseph Jacquard (1752-1834) — an entrepreneur and inventor of a weaving loom automation system.

Jacquard's system used a series of punched cards that regulated a series of sensing rods. One card was in position at a time and as the rods descended, those opposite a hole were free to move through, while the others were stopped by the card. The difference was sensed and magnified by mechanical linkages,

BINARY				OUT
8	4	2	1	
0	0	0	1	1
0	0	1	0	2
0	0	1	1	3
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6
0	1	1	1	7
1	0	0	0	8
1	0	0	1	9

Fig 30

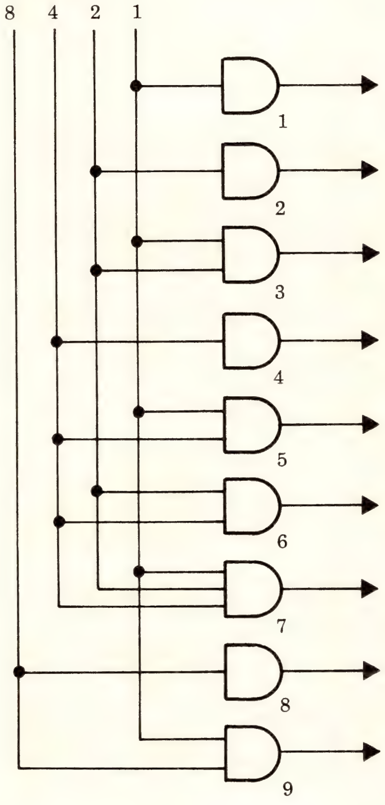

Fig 31

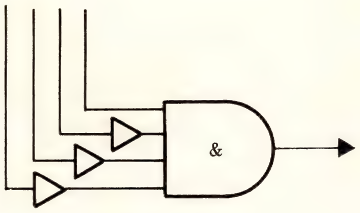

Fig 32

thus affecting the rise or fall of individual threads in the loom. A set number of warps was fed through the shuttle shed in this position before the sensing rods rose, the next card was fed into position, and the whole process was repeated. The cards were bound together in a large loop and thus the program was unending. Obviously, by inserting a different set of cards the machine would weave a different pattern. It was an interesting idea — especially at that time — and the great English mathematician Babbage was working on an adaptation of it to control his 'analytical engine' at the time of his death in 1871.

The method is capable of wide variation and application. One is reminded of the frequently advertised charts that purport to teach the novice how to play the piano in an evening. Such charts are placed over the keyboard and various ingenious colour, numbering and lettering systems harmoniously link keys together. It was something like that which was required to turn the switch-operated calculator into a self-organising computer. What was wanted was some gadget to handle all the switching. The transistor makes a very fast switch and all that was needed was something — anything — to which we could say in effect, "Fred — take whatever you've got in Register A and shove it in memory C." The 'what's-it' would then switch the appropriate gates, the counter would count eight pulses, shifting the data, and the end of the count would signal back to the what's-it that the operation was complete. The what's-it would then fetch the next it that the operation was complete. The what's—it would then fetch the next instruction and the cycle would be repeated, as with the programming already met in connection with the cardboard computer.

An intermediate stage came first, however.

Multiplexing

This is a big word that simply means controlling a lot of lines with a few. Let's imagine that we have 16 gates to control by hand. One way would be to have 16 switches — one for each gate — laid out schematically on a plan. The way forward, however, is to adopt a binary scheme.

Remember the grocer and his weights? When he wished to weigh 5 ounces, he used the 4 ounce weight and the 1 ounce weight, and you will remember that with just four binary bits we may therefore represent 16 numbers. So with switches. With just four switches — and thinking of their output as binary bits — we can control 16 gates. As with the grocer, when we wish to open gate 5, we flip switches 1 and 4.

The method is shown in Figure 31. If you follow the diagram carefully, you'll see that the switch marked 1 opens every other gate; the switch marked 8 opens the last two (only nine have been shown for clarity), and so on. Compare Figures 30 and 31.

Of course, it's not as simple as that! Suppose for example that, wishing to open gate 7, we flipped switches 1, 2 and 4. Doing that we'd find that in addition to gate 7, we'd also opened gates 1, 2, 3, 4, 5 and 6 — not a desirable state of affairs at all. But think back to a similar problem associated with sorting numbered cards in the binary selection box; the two problems are in fact different representations of the same thing. And the solution is the same — the realisation that (eg) decimal 3 is NOT 8 AND NOT 4 as well as 2 AND 1.

What's required therefore is an additional NOT output from each switch, to be taken to every gate not to be opened until the switch requires it — in other words, deliberately and permanently holding the output low until we equally deliberately switch it high.

The method is shown in Figure 32 and, clearly, all the extra lines could not have been drawn into Figure 31 without producing a very daunting diagram.

The next step came when it was realised that numbering individual gates was only a means to an end. What was *really* required was the switching of *sets* of gates, because it's these that perform different functions. The reader will see that an adaptation of Figures 31 and 32 will do this set-switching, while a glance back at Figure 28 will help him her to realise the need.

We are now very close to the modern computer. The final step is for the *computer itself* to do the necessary switch selection — some means whereby it will in effect control itself. Consider — we have gates to take care of the manipulation of data and these are controlled by switches. The data *and* the control switching are binary, so can we somehow bring the two together.

In the event, it proves remarkably easy. First, we provide a special memory location called a Control Register (it's a memory, like any other). The outputs from this memory are paralleled as in Figure 29 and they are coded so as to operate the desired gates in the multiplex mode just described.

We also provide another special memory called a Program Counter, which keeps track of where the next instruction is coming from. The program Counter points to (say) memory location A07F and the computer fetches the contents of A07F and stores it in the Control Register. The counter is then incremented by 1. As a result of the contents now in the Control Register, gates are opened and the computer does something. When the clock has counted off eight bits, a signal is flashed and the cycle is repeated. The counter now is pointing at A080; the contents are fetched, put into the Control Register and the next operation performed. It really is that breathtakingly simple in concept. *Now* our students should be able to see why we brought in a study of Jacquard's loom, and all the other things!

Consider speed for one moment. The delays introduced by a human operator are totally eliminated; there are no errors of switching and no waiting. We can progressively increase clock speed until the transistors of the multifarious gates are switching as fast as they can go (typically a million times a second) and the whole series of operations can proceed at breakneck speed. Nevertheless, it must be stressed over and over again to our students that, despite the speed, every single thing about it is still proceeding logically and sequentially.

I often regret dismantling my early computers. One in particular had the useful facility of one being able to slow down the clock at will — in order to watch the transfer of binary digits as represented by little lamps. A modern version of this design would have much to commend it as a teaching aid.

The two errors in the second solution of Figure 23 are as follows: (a) no differentiation between father's mother and father's father, and (b) the first OR should be a NOR.

APC TINY COMPILER

Peter McDonald presents a tiny Basic compiler, designed as a 16k TRS-80 games programming language rather than a subset of Basic. It occupies about 7k of RAM (though Peter feels this will be reduced substantially in future versions) and produces object code executing between 2 and 100 times faster than the source.

Introduction

Most TRS-80 owners have experienced the frustration of writing an elaborate games program containing the usual lasers, aliens, missiles and explosions only to have the interpreter process the masterpiece like a 78 being played at 33 rpm. It isn't really very funny – especially as the only way to salvage anything from the hours of programming is to drastically strip many of the niceties from the game resulting in an overly simple staccato "Space Invaders" or whatever. I had done that several times before realizing I should learn assembly language; that worked very well but naturally programming time increased and I started looking for a compromise between interpretive Basic and assembly language. The result is a tiny Basic compiler containing what I consider to be the necessities of a games programming language. It resides in low user RAM to compile the source code into high memory above the memory size.

Execution speed of the object code is very much determined by the type of statement being executed. For example, POKE statements have executed at over ninety times faster than interpretive Basic while complicated mathematical expressions may only execute twice as quickly as interpretively. So, keep complicated evaluations to a minimum and you'll be trying to slow the program down!

The language

What follows is a brief description of the syntax of each statement in the APC Compiler*.

CLS: As in Level II Basic, it clears the screen and returns the cursor to the top left hand corner.

POKE expression^{1}, expression^{2}: eg, POKE A+B,C. Puts the result of expression^{2} into the byte specified by expression^{1}.

Assignment of Variables VAR = Expression: eg, A=B+ PEEK(C)+A After execution the value of the variable will be that of the expression.

Operands: The APC Compiler allows only for simple integer arithmetic (+, -, /, *) in the normal Level II Basic integer range +32767 to -32766. Unlike Level II Basic they are executed in order from left to right as they appear in the expression, so 6+4/2 will result in 5 rather than the correct value of 8. This difference is particularly important when developing a program and testing it interpretively.

PEEK (expression): eg, A=PEEK (B+C) would assign A with the value of the contents of the byte defined by B+C.

IF expression $\lesseqgtr$ expression THEN statement ELSE statement: eg, If PEEK(A) < B+PEEK (C*D) THEN 250 ELSE E=193*F : CLS : GOTO 100 Note that after the THEN, a GOTO is optional. Either of the three conditions =, <, or > may be used in the text but no combinations are allowed (afterall expression^{1} <= expression^{2} is exactly the same as expression^{2} > expression^{1}). Also note that an IF statement cannot be either of the statements so IF . . . THEN IF . . . is not permitted – the compiler will alert you to this if you try. The ELSE is optional.

INC A: will increment the value of the variable by one. I inserted this statement to simplify the use of loops without a FOR NEXT loop.

Loops can easily be constructed using the INC & IF THEN statements, eg:

```
 90  A=O
100  PRINT "LOOP";
110  INC A : IF A< 50 THEN 100
```

MOVE expression TO expression FOR expression: eg, MOVE 12288 TO 15360; FOR 1024. I admit I've stolen MOVE from Ian Davies' APC-80; it is very useful in graphics and is *VERY* fast.

DATA, READ & RESTORE: eg

```
DATA 1, 2
DATA 3, 4, 5, 6, 7, 80, 95
READ A, B, C
PRINT A; B; C
```

will result in "1 2 3" being printed. A comma must be used between elements of the DATA statements and any number of DATA statements may be used in a program each element requiring 2 bytes of storage in RAM. As in Level II Basic, the RESTORE statement will return a pointer to the beginning of the DATA statements so the next element READ is the first element of the first DATA statement.

BEEP frequency, duration: eg BEEP A+B, 200. Again a lift from APC-80. Both the frequency and duration can have values between 0 & 255 but for the sake of execution speed I suggest the duration be kept fairly short. A square wave signal is output through the AUX line of the cassette interface which should be connected to a speaker or amplifier.

INPUT variable: eg INPUT AB, C In this example, a question mark will appear on the screen as in Level II Basic and the ENTERed value will be given to the variable AB. A second single (unlike Level II) question mark will be displayed and the ENTERed value given to C.

As many variables as required may be INPUT using the one statement, each one being separated by a comma (no semi-colons permitted). There is no provision for string input.

GOTO and GOSUB: eg GOSUB 1200 These are exactly the same as in Level II Basic. To return from a GOSUB use the

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RETURN statement.

RND(255): eg A = RND(255) will give the variable A a value between 0 and 255. Unfortunately my random number generator can only select values in this range so I made the three numerals inside the brackets mandatory. This results in compatibility with the interpreter's RND statement ie, a value between 0 and 255 will be selected.

As the APC Compiler uses only integer Basic it is possible to select random numbers from smaller ranges; for example, 0 to 127 can be found using A = RND(255)/2.

END: This statement will return the computer to Level II Basic and must be inserted at the end of a program if the last statement doesn't direct program control elsewhere. So

```
150 PRINT A
160 END
```

and

```
150 PRINT A
160 RETURN
```

are both permitted as the last two lines of a source program.

PRINT: eg, PRINT @ 256, "A="; A and PRINT 1288; "="; A+B/C
The PRINT statement is very similar to Microsoft's version, the main difference being the exclusion of the comma as a delimiter between variables, numerals and strings (so PRINT A,B is not allowed) and the absence of PRINT USING. Other than that, it's the same, including a question mark as an abbreviation for PRINT and optional inverted commas at the end of a program line.

Using the APC compiler

First of all, key Listing 1 into your TRS-80 with no spaces between characters and save it on tape. Next month I'll present a documented, expanded version of Listing 1 which is very much more readable than the compressed version presented this month. It should occupy about 7k of RAM and requires ½k to 1k in order to operate efficiently. User RAM begins at 17129 (decimal) so the compiler will occupy memory from there to around 25000. This leaves 7½k for source and object code so memory size should be set to 28500 (the object code will usually occupy more RAM than the source).

Type in the source code using line numbers greater than those of the compiler so it sits in higher memory than the compiler does.

It is possible to RUN the source code interpretively although several inconsistencies such as RND(256), MOVE TO FOR, and INC will present problems. MOVE TO FOR can be overcome by loading APC-80 into high memory (but remember after the first compilation, it may be obliterated by the object code); RND can be overcome by using the parameter of 255 between the brackets; and Ian Davies has promised me a future version of APC-80 will contain the INC statement. INC *variable* should be used wherever possible as it is much quicker at execution time than *variable = variable + 1* and occupies about 10 bytes less.

Variables can be of any length though, as in Level II Basic, only the first two characters are significant. No string variables are permitted, nor are arrays (yet!).

I deliberately did not include an INKEY function because it is just as simple to PEEK the keyboard which is at memory locations 3801H, 3802H, 3804H, 3808H, 3810H, 3820H, 3840H & 3880H. Each bit of every keyboard byte corresponds to a particular key so when the right array is pressed, for example, and no others from that byte, then PEEK(3840H) will return a value of 64 (Decimal). Refer to a TRS-80 Technical Reference manual or page 59 of Micro-80's Level II ROM Reference Manual.

Comments headed by REM or ' are permitted but will not be inserted in the object code. I suggest these are used sparingly if at all as you are probably going to have enough trouble fitting your complex program into the 3½k allocated to source code.

When you've completed typing in the source code and tested it, interpretively, as best you can (replacing *INC A* with A=A+1 etc. and loading APC-80 to handle the MOVE TO FOR statements), RUN the compiler. First it asks from where and to where it should compile (presumably the first and last lines of your source code) and asks if interrupts are required. If your program can get itself into a loop or you're not entirely sure that the source is bug-free it's a good idea to reply with a "Y" to this question. The compiler will then insert appropriate code each time it encounters a new line of source code which will respond in the normal way to the BREAK and shift @ keys. This additional code amounts to three bytes per line of source so if you're tight for room or want the object code to work faster then don't insert the interrupt facility.

Once the compiler has finished (which even for a small program could take a couple of minutes), the object code can be executed by typing 'SYSTEM' and replying to the question mark with '/', 'ENTER'. Try the source code in Listing 2 because I know it works. If it doesn't you've probably made a mistake in typing in the compiler.

In the April issue of APC, page 49, Ian Davies presented a "System Tape Generator". This can be used to store the object code on tape – a far more elegant method than CSAVEing both the compiler and source and recompiling every time you want to use the program. To use his program, CLOAD it from tape (obliterating source code and compiler), POKE 16561 with 0 and POKE 16562 with 86. This changes the memory size to 22016, so when the System Tape Generator asks where to put the routine, reply with 22020. The start address of dump is the original memory size you nominated which should have been around 28500; the number of bytes to dump will be the difference between the top of memory, 32767, and the original memory size; and the entry point of dump is the original memory size plus 106.

Next month I'll be going into the details of how the program works, presenting some improvements, showing how larger machines can send the object code into low memory (to allow compilation of large source codes) and how the compiler size can be reduced. I'll also present a games program I've written for the compiler.

Listing 1

```
10 CLEAR 100:P=PEEK(16561)+PEEK(16562)*256+2:MS=P:B=PEEK(16548)+PEEK(16549)*256:TM=32767:CLS:PRINT@74,
"APC COMPILER":PRINT:INPUT"COM
PILE FROM LINE NUMBER ";X:INPUT"TO LINE NUMBER ";YE:INPUT"ARE INTERRUPTS REQUIRED IN OBJECT
     CODE  (Y/N) ";S$
20 IFS$="Y"THENFS=1
30 GOSUB840:Z=MS+106:GOSUB790:POKE16607,Z1:POKE16608,Z2:END
40 A=X:GOSUB840:S=B:A=YE:GOSUB840:YE=PEEK(B)+PEEK(B+1)*256-1:X=S:S=S-2:VAR$="":NL=0
50 S=S+4:FG=1:NL=NL+1
60 A$="":GOSUB830:GOSUB640:IFS>=YETHEN80ELSEIFPNX=0THEN50ELSEIFPNX=34THENFG=FG*-1
70 GOSUB690:IFA$=""THEN60ELSES=S-1:PX=PEEK(S):PNX=PEEK(S+1):L=LEN(VAR$):FORPS=1TOLSTEP2:
IFMID$(VAR$,PS,2)=A$THEN60ELSENEXT:IFL=250TH
ENPRINT"OUT OF VARIABLE STORAGE SPACE";:ENDELSEVAR$=VAR$+A$:GOTO60
80 DIMLN%(NL,2):S=X:NL=0
```

```
90 NL=NL+1:LN%(NL,0)=PEEK(X+2)+PEEK(X+3)*256:X=PEEK(X)+PEEK(X+1)*256:IFLN%(NL,0)=ATHEN100ELSE90
100 L=0:P=MS+106:FG=1:A$="":X=0:PX=0:PNX=0:LN=0:PS=1:ANB=0:NS=5:DIMF(NS),E(NS),F1(NS),F2(NS):Z=MS+61:
GOSUB790:POKEP,205:POKEP+1,Z1:P  OKEP+2,Z2:P=P+3


 110 NEXLN=PEEK(S)+PEEK(S+1)*256:LN=LN+1:S=S+3:LN%(LN,1)=P:PRINT@515,"COMPILING LINE NUMBER ";
 LN%(LN,0):IFFS=1THENPOKEP,205:Z=MS+88:G
  OSUB790:POKEP+1,Z1:
  POKEP+2,Z2:P=P+3


  120 GOSUB830:IFS=YETHEN1020ELSEIF(PX=147)OR(PX=147ANDPNX=251)OR(PX=0)
 THENS=NEXLN:GOTO110ELSEIFPX=10ORPX=32ORPX=58ORPX=140THEN120ELSE
  GOSUB740:GOTO120
  130 POKEP,205:POKEP+1,201:POKEP+2,1:P=P+3:RETURN
  140 IFX=4POKEP,195ELSEPOKEP,205
  150 ANB=1:GOSUB650:POKEP+1,RX:POKEP+2,RY:P=P+3:RETURN
  160 POKEP,201:P=P+1:RETURN
  170 GOSUB640:GOSUB690:IFA$=""THEN730ELSEGOSUB770:POKEP,205:POKEP+1,179:POKEP+2,27
  :POKEP+3,215:POKEP+4,205:POKEP+5,101:POKEP+6,14
  :POKEP+7,205:POKEP+8,127:POKEP+9,10
  :POKEP+10,42:POKEP+11,33:POKEP+12,65
  :POKEP+13,34:POKEP+14,Z1:POKEP+15,Z2

  180 P=P+16:GOSUB640:IFPNX=44GOSUB830:GOTO170ELSERETURN
  190 GOSUB850:POKEP,213:P=P+1:GOSUB830:GOSUB850:POKEP,225:POKEP+1,115:P=P+2:RETURN
  200 GOSUB830:GOSUB830:GOSUB830:F(W)=0:GOSUB850:POKEP,213:P=P+1:GOSUB830:F(W)=0:GOSUB850:POKEP,
       225:P=P+1:Z=MS+7:GOSUB790:POKEP,205:PO
        KEP+1,Z1:POKEP+2,Z2
        :P=P+3:RETURN

  210 GOSUB640:IFPNX=64GOSUB270
  220 IFPNX<>34THEN280ELSES=S+1:PX=PEEK(S):PNX=PEEK(S+1):ANB=3
  230 IFPNX<>34ANDPNX<>0THENPOKEP+ANB,PNX:ANB=ANB+1:S=S+1:PX=PEEK(S):PNX=PEEK(S+1):GOTO230ELSEIFPNX=
      0THEN240ELSEGOSUB830:IFPNX=44POKEP

 +ANB,9:POKEP+ANB+1,0:ANB=ANB+2:GOSUB830
 :GOTO250ELSEIFPNX=59POKEP+ANB,0:ANB=ANB+1:GOSUB830:GOTO250

  240 POKEP+ANB,10:POKEP+ANB+1,0:ANB=ANB+2
  250 Z=P+ANB:GOSUB790:POKEP,195:POKEP+1,Z1:POKEP+2,Z2
  :Z=P+3:GOSUB790:P=P+ANB:POKEP,33:POKEP+1,Z1:POKEP+2,Z2:POKEP+3,22:POKEP+4,0:POKEP+5,205:POKEP+6,
   10:POKEP+7,47:ANB=8:P=P+ANB:RETURN

 260 GOSUB640:IF(PNX>63ANDPNX<91)ORPNX=34OR(PNX>47
 ANDPNX<58)THEN210
 270 GOSUB830:GOSUB850:POKEP,237:POKEP+1,83:POKEP+2,32:POKEP+3,64:ANB=4:P=P+ANB:GOSUB830:RETURN
 280 GOSUB850:POKEP,237:POKEP+1,83:POKEP+2,33:POKEP+3,65
 :POKEP+4,62:POKEP+5,2:POKEP+6,50:POKEP+7,175:POKEP+8
 ,64:POKEP+9,205:POKEP+10,189:POKEP+11,15
 :POKEP+12,205:POKEP+13,10:POKEP+14,47
 290 IFPNX<>59THENPOKEP+15,205:POKEP+16,254:POKEP+17,32:
 ANB=18:P=P+ANB:GOTO300ELSEGOSUB830:P=P+15

 300 GOSUB640:IF(PNX>63ANDPNX<91)ORPNX=34OR(PNX>47
 ANDPNX<58)THEN210ELSERETURN
 310 IFDF=0THENDO=TM-LEN(VAR$)-1:DF=1:L=0
 320 GOSUB800:IFA$=""THEN730ELSEPOKEDO-L,Z1:POKEDO-L+1,Z2:L=L+2:GOSUB640:IFPNX=0ORPNX=58
    THEN330ELSEGOSUB830:GOTO320
 330 IFDO-L<=PTHENPRINT"OM ERROR":ENDELSERETURN
 340 POKEP,205:Z=MS+22:GOSUB790:POKEP+1,Z1:POKEP+2,Z2:GOSUB640:GOSUB690:IFA$=""THEN730ELSEPOKEP+3,
    62:POKEP+4,2:POKEP+5,50:POKEP+6,175
```

```
:POKEP+7,64:P=P+5:POKEP+3,17:POKEP+4,Z1:POKEP+5,Z2
:Z=MS+4:GOSUB790:POKEP+6,42:POKEP+7,Z1:POKEP+8,Z2

350 POKEP+9,205:POKEP+10,210:POKEP+11,9
:P=P+12:GOSUB640:IFPNX=44GOSUB830:GOTO340ELSERETURN
360 Z=DO+2:GOSUB790:POKEP,33:POKEP+1,Z1:POKEP+2,Z2
:Z=MS+4:GOSUB790:POKEP+3,34:POKEP+4,Z1:POKEP+5,Z2
:P=P+6:RETURN
370 GOSUB830:IFPNX<>86THEN730ELSEGOSUB830:IFPNX<>69THEN730ELSEGOSUB830:GOSUB850:POKEP,
    213:P=P+1:GOSUB830:IFPX<>189THEN730ELSEGOSUB85

0:POKEP,213:P=P+1:GOSUB830:IFPX<>129THEN730ELSEGOSUB850:POKEP,213:POKEP+1,193:POKEP+2,209:POKEP+3,225

380 POKEP+4,205:Z=MS+40:GOSUB790:POKEP+5,Z1:POKEP+6,Z2
:P=P+7:RETURN
390 POKEP,195:POKEP+1,204:POKEP+2,6:P=P+3:RETURN
400 S=S-2:GOSUB830:GOSUB690:F1(W+1)=Z1:F2(W+1)=Z2:GOSUB640:IFPNX<>213THEN730ELSEF(W)=0:
    GOSUB830:GOSUB850:RETURN

410 GOSUB830:IFPNX<>40THEN730ELSEGOSUB830:GOSUB850:POKEP,213:POKEP+1,225:IFF(W)=0THENPOKEP+2,
     22:POKEP+3,0:POKEP+4.94ELSE

POKEP+2,110:POKEP+3,38:POKEP+4,0
420 P=P+5:GOSUB830:RETURN
430 GOSUB830:GOSUB830:GOSUB830:GOSUB830:GOSUB830
:GOSUB830:IFPX<>41THEN730ELSEPOKEP,237:POKEP+1,95:IFF(W)=0THENPOKEP+2,22:POKEP+3,0:POKEP+4,95
ELSEPOKEP+2,38:POKEP+3,0:POKEP+4,103
440 P=P+5:RETURN
450 GOSUB830:GOSUB830:GOSUB640:GOSUB690:POKEP,42:POKEP+1,Z1:POKEP+2,Z2:POKEP+3,35:POKEP+4,34:POKEP+5,
 Z1:POKEP+6,Z2:P=P+7:RETURN

460 Z=MS+6:GOSUB790:F1(W+1)=Z1:F2(W+1)=Z2:F(W)=0:GOSUB850:GOSUB830:IFPX=213THENTY=1
470 IFPX=212THENTY=2:IFPNX=213THENTY=4
480 IFPX=214THENTY=3:IFPNX=213THENTY=5
490 F1(W+1)=0:F2(W+1)=0:GOSUB850:Z=MS+6:GOSUB790:POKEP,42:POKEP+1,Z1:POKEP+2,Z2
:POKEP+3,205:POKEP+4,57:POKEP+5,10
:TP=P+6:IFTY=2ORTY=3THENANB=12ELSEANB=9
500 P=P+ANB:IFPNX=202GOSUB830
510 GOSUB640:IFPNX=58GOSUB830:GOTO510ELSEIFPNX=149THEN520ELSEIFPNX=0THENEB=P:GOTO550ELSEGOSUB630:GOTO510
520 GOSUB830:TE=P:ANB=3:P=P+ANB:EB=P
530 IFPNX=58THENGOSUB830:GOTO530ELSEIFPNX=32THENGOSUB640
540 IFPNX=0THENZ=P:GOSUB790:POKETE,195:POKETE+1,Z1:POKETE+2,Z2:GOTO550ELSEGOSUB630:GOTO530
550 Z=EB:GOSUB790:ONTYGOSUB560,570,580,590,600
:RETURN
560 POKETP,194:GOSUB610:RETURN
570 POKETP,202:GOSUB610:POKETP+3,250:GOSUB620:RETURN
580 POKETP,202:GOSUB610:POKETP+3,242:GOSUB620:RETURN
JPZ,Z2Z1HJPP,Z2Z1H
590 POKETP,250:GOSUB610:RETURN
600 POKETP,242:GOSUB610:RETURN
610 POKETP+1,Z1:POKETP+2,Z2:RETURN
620 POKETP+4,Z1:POKETP+5,Z2:RETURN
630 IFPNX=143THEN730ELSEGOSUB830:GOSUB740:RETURN
640 IFPNX=32THENS=S+1:PX=PEEK(S):PNX=PEEK(S+1):GOTO640ELSERETURN
650 A$="":GOSUB640
660 IFPNX>47ANDPNX<58THENA$=A$+CHR$(PNX):GOSUB830:GOTO660ELSEA=VAL(A$):FORX=1TONL:IFLN%(X,0)<>ATHENNEXTELSE680
670 PRINT"UNDEFINED LINE IN ";LN%(LN,0):END
680 RY=INT(LN%(X,2)/256):RX=LN%(X,2)-INT(LN%(X,2)/256)*256:LN%(X,2)=P+ANB:RETURN
690 A$="":IF(PNX>64ANDPNX<91)ANDFG=1THENA$=CHR$(PNX)
ELSERETURN
700 GOSUB830:IF(PNX>64ANDPNX<91)OR(PNX>47ANDPNX<58)THENA$=A$
+CHR$(PNX):S=S+1:GOSUB720ELSEA$=A$+" "
```

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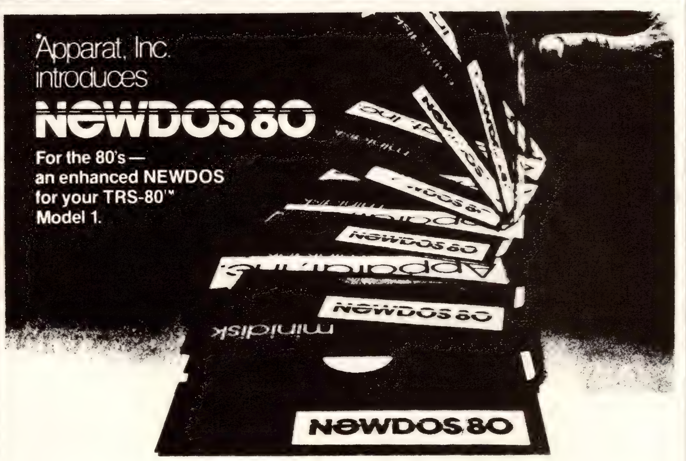


Apparat, Inc. introduces

NEWDOS 80

For the 80's —
an enhanced NEWDOS
for your TRS-80™
Model 1.

Apparat, Inc., announces the most powerful Disk Operating System for the TRS-80®. It has been designed for the sophisticated user and professional programmer who demands the ultimate in disk operating systems.

NEWDOS/80 is not meant to replace the present version of NEWDOS 2.1 which satisfies most users, but is a carefully planned upward enhancement, which significantly extends NEWDOS 2.1's capabilities. This new member to the Apparat NEWDOS family is upward compatible with present NEWDOS 2.1 and is supplied on Diskette, complete with enhanced NEWDOS + utility programs and documentation. Some of the NEWDOS/80 features are:

- New BASIC commands that supports files with variable record lengths up to 4095 Bytes long
- Mix or match disk drives. Supports any track count from 18 to 80. Use 35, 40 or 77 track 5" mini disks drives or 8" disk drives, or any combination
- A security boot-up for BASIC or machine code application programs. User never sees "DOS READY" or ">READY" and is unable to "BREAK", clear screen, or issue any direct BASIC statement including "LIST"
- New editing commands that allow program lines to be deleted from one location and moved to another or to allow the duplication of a program line with the deletion of the original
- Enhanced and improved RENUMBER that allows relocation of subroutines
- Powerful chaining commands
- Print Spooler
- DFG function, simultaneous striking of the D, F and G keys will allow the user to enter a mini-DOS to perform some DOS commands without disturbing the resident program (e.g. dir while in scripsit.)
- Upward compatible with NEWDOS 2.1 and TRSDOS 2.3
- Includes machine language Superzap/80 and all Apparat 2.1 utilities
- Enter debug any time by pressing 123 keys. Also allows disk I/O
- Diskette "Purge" command
- Specifiable system options (limited sysgen type commands)
- Increased directory capacity
- Copy by file commands

NEWDOS/80 with all of the NEWDOS + utility programs, many of which have been enhanced, is priced at just $149.00 and is available at most TRS-80 dealers.

As with 2.1, NEWDOS/80 relies on the TRSDOS and Disk Basic Reference Manual published by Radio Shack. NEWDOS/80 documentation supports its enhancements and upgrades only.

only $149

Adapter for TRS-80* computer eliminates disk read errors

[illegible]

The problem [illegible] has been [illegible] perform the [illegible] data pulses.

As explained in the *Backgrounder* [illegible] the [illegible] clock separa[illegible] the manufacturer of the [illegible] warns against.

The De Forest solution [illegible] PC card adaptor called the DATA SEPARATOR eliminates the problem by substituting an explicit data separator [illegible] which has been used reliably in disk controllers since 1977 [illegible] for the internal IC separator circuit.

The DATA SEPARATOR is installed without modifying the host system. The user merely removes the FD1771 IC from the host controller, installs the IC in the DIP socket on the SEPARATOR card and plugs the adaptor into the vacated socket of the host controller and then [illegible] two wires.

We caution that opening the Expansion Interface of the TRS 80* computer which is required to install the SEPARATOR may void the computer's limited 90 day warranty.

The SEPARATOR which sells for $29.95 may be purchased from De Forest dealers or ordered direct from De Forest Software. Payment for mail orders may be made by cheque or money order or charegd to a BANKCARD account.

Adaptor fixes TRS 80 computer disk controller*

CRC ERROR! TRACK LOCKED OUT!

Technical Staff
Percom Data Company

This problem started while we were studying an annoying problem with the TRS 80* computer. Disk drives sold by Percom are realigned and tested before shipment. We noticed, however, that some disk drives would pass the Percom inspection but just would not work reliably on the inner tracks with a TRS 80* computer. These drives were within the manufacturer's specifications and would function perfectly on other disk systems Percom manufactures — perfectly here meaning more than 50 million bytes read without error!

The [illegible] the TRS 80* [illegible] data separat[illegible] 1771 [illegible] the [illegible] 1771 [illegible] recommended by Western [illegible] manufacturer. [illegible] on page 17 of the FD1771 data sheet.

Internal data separation may work for some applications. However for applications requiring high data recovery reliability WDC recommends external data separation be used.

We suspected the data separator because the problem was most severe on disk inner tracks where storage density is highest and data separation is most critical.

To prove our point a technician breadboarded a standard Percom data separator circuit and configured it to plug directly into the FD1771 IC socket of the TRS 80* computer controller.

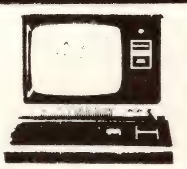
When connected to the TRS 80* computer a troublesome drive functioned perfectly! We ran a BACKUP utility many times and never got a track lockout. Before we added the external data separator circuit to the computer, this same drive would always lock out tracks, and would have difficulty reading from the inner (higher number) tracks.

The data separator circuit fixes the mini disk controller of the TRS 80* computer. The type of drives being used is irrelevant; the circuit eliminates disk read errors resulting from the inability of the Tandy controller design to reliably separate clock and data signals when reading high density inner tracks.

This Australian Unit has been designed and produced for deForest Software **ONLY $29.95**

HIGH RESOLUTION FOR THE TRS-80*

- AVAILABLE NOW
- LIMITED SUPPLY
- SEPARATE POWER SUPPLY
- NOT A KIT!
- INSTALLS IN SECONDS — JUST PLUG IN!



- DOES NOT CONFLICT WITH BASIC
- WORKS WITH ANY DOS
- DOES NOT AFFECT WARRANTY!
- 384 x 194 RESOLUTION
- UPPER CASE AND LOWER CASE WITH DESCENDERS

SUPER 80 is a unique Australian invented and manufactured hardware/software package which will integrate high speed, high resolution graphics into any level II TRS-80 system. The installation of **SUPER 80** will not affect normal operation of the TRS-80. A fully buffered expansion and edge connector is provided so that other peripherals may be used. Fully protected against over voltage.

*Comes complete with
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POWER SUPPLY
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CABLE

ONLY **$439.00**

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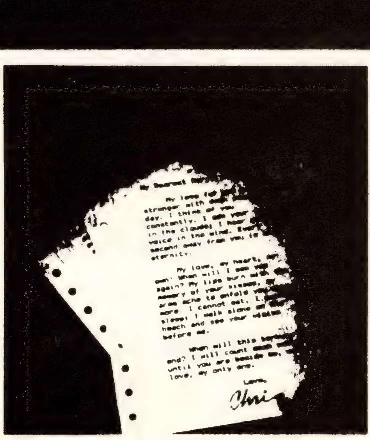


We're known for our fine print.

- Lower case has descenders.
- Can be used on TRS80 without expansion interface, with no extra hardware.
- Adjustable pin feed
- 9 x 9 matrix

THE GOOD NEWS

PRICE LIST

TRS80 with exp int	$949*
TRS80 w/out exp int	$949*
APPLE	$989
HPIB (IEEE)	$989
RS232	$989
Centronics	$949
Cable for Centronics or w/interface model	$ 35

* Please specify

Epson.

The type you get out of most printers you wouldn't send to your maiden aunt, much less use for your *important* correspondence. And up to now, in order to get a dot matrix hardcopy you could really call correspondence quality, you had to spend on the high side of a thousand bucks.

Not any more.

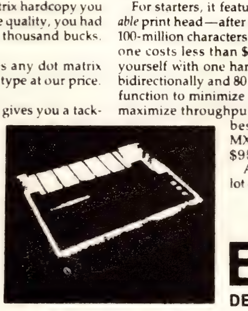
The Epson MX-80 challenges any dot matrix printer anywhere to match our type at our price. Or even come close.

Our emphasized print mode gives you a tack-sharp, clean, easy-to-read face with true descenders—at a fraction of the price of daisy wheel printers. We give you a user-defined choice of twelve different weights and sizes of letters in 40, 80, 66 or 132 columns. We give you adjustable tractors so you can do anything from labels to memos to manuscripts. Fast and clean.

But if you think print quality is the only thing we have to sell, you're wrong. The MX-80 may be the most revolutionary printer to come out in the past ten years.

For starters, it features the world's first *disposable* print head—after it's printed between 50 and 100-million characters, just throw it away. A new one costs less than $40 and you can change it yourself with one hand. Plus, the MX-80 prints bidirectionally and 80 CPS with a logical seeking function to minimize print head travel time and maximize throughput. Finally—and this is the best part—you can buy an MX-80 right now for less than $950.

And that's what we call a lot of fine print for the money.



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I'M A BELIEVER !!

"**I Love it !!. . .It's really a incredible O/S. It' just great! Now I see why people who have seen it say they are now believers. I know I am.**" *LANCE MICKLUS*

1) Large (8") drive support.
2) Double Sided drive support.
3) Double Density drive support.
4) 80 Track drive support.
*NOTE all above drives may be mixed on any one system and can be configured at Sysgen time or during any Backup!
5) Winchester technology fixed drive support.
6) Supports any combination of the above drives up to a max. of 8 drives.
7) Supports double-speed processor clock modifications. (Archbold for example)
8) FASTER! —— Improved overlay structure using ISAM accessing techniques improves loading times by up to 1400%.
9) General purpose output spoolers of a true, symbiont design provide simultaneous output and program execution without any user intervention.
10) Keyboard Type-Ahead feature permits you to enter keystrokes before your programs need them.
11) User definable keys, all 26 letters.
12) Built in Graphic string packer lets you enter graphic symbols into a BASIC program from the keyboard through the use of the (Clear) key. The (Clear) key is simply held down just like the (Shift) keys during other keystrokes and viola...graphics!
13) Dated files. —— All files are accompanied by the date of their last modification (great for my writer).
14) Marked files. —— All files are accompanied by a 'mark' if they have been modified since they were last backed up. This permits the BACKUP utility to copy only those files which have actually been updated since a previous backup.
15) File transfer by class. Allows transferring of all files of a similar directory classification such as /CMD, /BAS, /PCL, etc.

VTOS 4.Ø

VTOS 4.Ø
Operating System Diskette with Operator's Guide
$119.00

16) Built-in SYSTEM command contains lower case display driver, screen print, break key disable, blinking cursor, disk drive stepping rate and motor-on delay modifications, and more.
17) User may SYSGEN a custom VTOS system configuration containing special I/O drivers, device LINKing and ROUTEing, SPOOLing and DEBUG tasks, etc. which will be automatically loaded during the BOOT process without requiring a more lengthy AUTO and CHAIN procedure.
18) Non-BREAKable AUTO and CHAIN commands.
19) Wild-card DIRectory. Permits you to locate all files of a certain classification such as '/BAS'. Uniformly indicates file size in K (1024 bytes) regardless of drive type. DIR D" would give you all your files that start with "D".
20) Dynamic file name defaults in APPEND, COPY, and RENAME commands allow you to specify only minimal information about file names.
21) COPY and APPEND commands execute up to 300% faster.
22) ALLOCate command for pre-allocation and non-releasability of file space. File space will never shrink if this option used.
23) MEMORY command for directly setting upper memory limit.
24) Variable Length file support is incorporated which automatically blocks short user data records both within a sector and across sector boundaries thereby taking maximum advantage of disk file space.
25) No security disk needed to make backups or to run the system!
26) Though many O/S bear his design and code VTOS 4.Ø is the only Fully Aproved Operating System by Randy Cook! And it is FANTASTIC!
27) Endorsed by Scott Adams and Lance Micklus!

```
710 GOSUB770:RETURN
720 PX=PEEK(S):PNX=PEEK(S+1):IF(PNX>64ANDPNX<91)OR(PNX>96
ANDPNX<123)OR(PNX>47ANDPNX<58)THENS=S+1:GOTO720
ELSERETURN
730 PRINT"SYNTAX ERROR FOUND IN LINE ";LN%(LN,0):END
740 DATA132,145,146,141,137,177,178,136,139,144,143,128:FORX=1TO12:READA:IFPX=ATHENRESTORE:GOTO760ELSENEXT:

RESTORE:IFPX=77ANDPNX=79T

HENX=13:GOTO760ELSEIFPX=73ANDPNX=78ANDPEEK(S+2)=67THENX=15:GOTO760ELSEIFPX=66ANDPNX=69THENX=16:GOTO760
750 IFPX>64ANDPX<91THENX=14:GOTO760ELSEIFPX>47ANDPX<58THENS=S-1:PNX=PX:X=4:GOTO760
ELSE730

760 ONXGOSUB130,140,160,140,170,190,210,310,340,
360,460,390,370,400,450,200:RETURN
770 FORPS=1TO251STEP2:IFMID$(VAR$,PS,2)=A$THEN780ELSENEXT
780 Z=TM-PS+1:GOSUB790:RETURN
790 Z1=Z-INT(Z/256)*256:Z2=INT(Z/256):RETURN

800 A$="":GOSUB640:IFPX=206ANDPEEK(S-1)=213THENFM=1
810 IFPNX>47ANDPNX<58THENA$=A$+CHR$(PNX):GOSUB830:GOTO
810ELSEIFFM=1THENZ=65536-VAL(A$)ELSEZ=VAL(A$)
820 FM=0:GOSUB790:RETURN

830 GOSUB640:S=S+1:PX=PEEK(S):PNX=PEEK(S+1):RETURN
840 IFPEEK(B+2)+PEEK(B+3)*256<>ATHENB=PEEK(B)+PEEK(B+1)*256
:GOTO840ELSERETURN
850 W=W+1:IFW>NSPRINT"NESTING LEVEL TOO DEEP IN "
;LN%(LN,0):ENDELSEF(W)=0:E(W)=0
860 GOSUB640:IFPNX=0ORPNX=59ORPNX=44ORPNX=41ORPNX=189OR
PNX=129ORPNX=58ORPNX=212ORPNX=213ORPNX=214OR
PNX=202ORPNX=141ORE(W)=145THENGOSUB960:F(W)=0:
W=W-1:E(W)=0:RETURNELSEIFPNX>=205ANDPNX<=208THENGOSUB830
870 IFPNX=229GOSUB410
880 IFPNX=222GOSUB430
890 GOSUB690:IFA$<>""THENGOSUB980
900 GOSUB800:IFA$<>""THENGOSUB1000
910 GOSUB640:IFF(W)=0THENF(W)=1:E(W)=PNX:GOTO860ELSEIFE(W)=205THENPOKEP+1,210:POKEP+2,11:ANB=3

920 IFE(W)=206THENPOKEP+1,199:POKEP+2,11:ANB=3

930 IFE(W)=207THENPOKEP+1,242:POKEP+2,11:ANB=3

940 IFE(W)=208THENPOKEP+1,144:POKEP+2,36:POKEP+3,205
:POKEP+4,127:POKEP+5,10:ANB=6

950 POKEP,205:P=P+ANB:POKEP,237:POKEP+1,91:POKEP+2,33:POKEP+3,65:ANB
=4:P=P+ANB:E(W)=PNX:GOTO860
960 IFF(W)=0THEN730ELSEIFF1(W)<>0ORF2(W)<>0THEN
POKEP,237:POKEP+1,83:POKEP+2,F1(W):POKEP+3,F2(W)
:ANB=4:P=P+ANB:F1(W)=0:F2(W)=0
970 RETURN
980 IFF(W)=0THENPOKEP+1,91ELSEPOKEP+1,107
990 POKEP,237:POKEP+2,Z1:POKEP+3,Z2:ANB=4:P=P+ANB:RETURN
1000 IFF(W)=0THENPOKEP,17ELSEPOKEP,33
1010 POKEP+1,Z1:POKEP+2,Z2:ANB=3:P=P+ANB:RETURN
1020 FORX=1TO12:READY:NEXT:DATA42,0,0,43,43,34,0,0,237,91,0,0,223,192,205,3,32,201:FORX=22TO39:

READY:POKEMS+X,Y:NEXT:Z=MS+4:GOSUB790

:POKEMS+23,Z1:POKEMS+24,Z2:POKEMS+28,
Z1:POKEMS+29,Z2:Z=MS+2:GOSUB790:POKEMS+32,Z1:POKE
MS+33,Z2
1030 DATA229,183,237,82,225,218,0,0,237,176,24,8,9,43,235,9,
```

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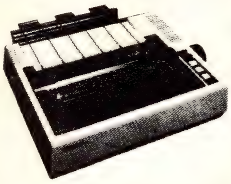

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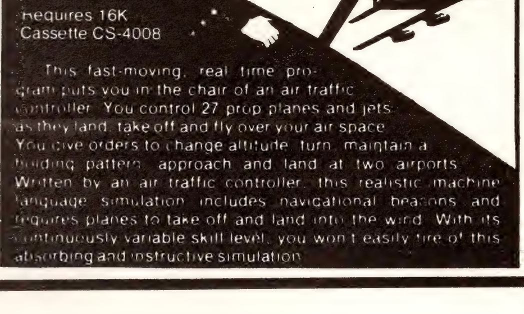

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WY/J3

```
43,235,237,184,201:FORX=40TO60:READY:POKEMS+X,Y:NEXT:Z=MS+52:GOSUB790:POKEMS+46,Z1:POKEMS+47,
Z2:DATA77,83,62,1,238,3,211,255,65,16,2
54,21,32,246,201:FORX=7TO21:READY:POKEMS+X,Y:NEXT

1040 DATA22,0,33,0,0,1,0,0,35,11,120,177,40,3,114,24,246,

33,0,0,34,0,0,0,0,0,201:FORX=61TO87:READY:POKEMS+X,Y:NEXT:DATA205,
88,3,183,200,254,96,204,132,3,50,153,64,61,192,
195,204,6:FORX=88TO105:READY:POKEMS+X,Y:NEXT:Z=TM-LEN(VAR$)+1:GOSUB790

1050 POKEMS+64,Z1:POKEMS+65,Z2:Z=LEN(VAR$)+1:GOSUB790:POKEMS+67,Z1:POKEMS+68,Z2:Z=DO+2:GOSUB790:

POKEMS+79,Z1:POKEMS+80,Z2:Z=MS+4:GOS

UB790:POKEMS+82,Z1:POKEMS+83,Z2:Z=DO-L:GOSUB790:POKEMS+2,Z1:POKEMS+3,Z2:FORX=1TONL:A=LN%(X,2)
1060 IFA=0THENNEXT:PRINT"COMPILATION COMPLETE":RETURN
1070 B=PEEK(A)+PEEK(A+1)*256:Z=LN%(X,1):GOSUB790:POKEA,Z1:POKEA+1,Z2:IFB=0THENNEXTELSEA=B:GOTO1070
```

Listing 2

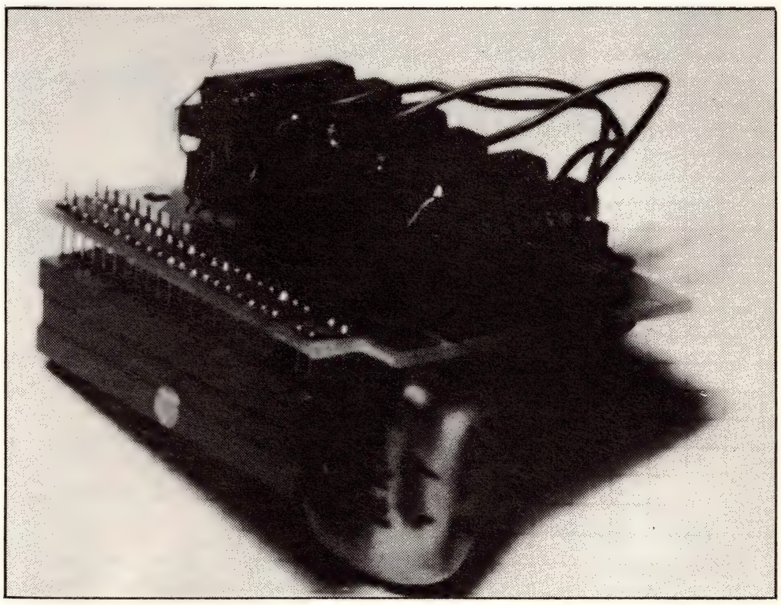
```
2000 A=15361
2010 A=A+1:POKE A,191:POKE A-1,32
2020 IF A=15361+1000 THEN 2070 ELSE 2010
2050 A=A-1:POKE A,191:POKE A+1,32
2060 IF A=15361 THEN 2010 ELSE 2050
2070 MOVE 12288 TO 15360 FOR 1023
2075 INC B:IF B<5000 THEN 2075
2078 CLS
2080 INPUT X,Y
2090 PRINTX;Y
2100 DATA1,2,3
2110 READA,B:PRINTA;B
2120 RESTORE:READA:PRINTA
2130 IFA=3THENPRINT"HELLO"ELSE2140
2140 POKE15360+512,129
2150 PRINTPEEK(15360+512)
2160 PRINT"FINISHED"
2170 END
```

"Take no notice of Jim, he's playing strip poker with his computer."

ZX80 CORNER

The material for this ZX80 page in Australian Personal Computer comes from the National ZX80 Users Club.
Details about the Club can be found at the end of this article.
The National Users' Club welcomes comments and suggestions for this ZX80 page.

7k expansion for Sinclair ZX80



We have received the following hardware modification from Mr Simon Ernst of Wheelers Hill, Victoria, for those people with the standard 3k expansion kit who wish to add on additional memory. Because the expansion pack provided by Sinclair has some select pins which are not used, it is possible to achieve an additional 3k (ie a total of 7k) for about $30.00.

This is done as follows:

Six (1024x4 bit static RAM) or MM2114N can be piggy-backed on to an existing I.C. in RAM.
Leave pin 8 of all six I.C.'s free.
Then if we consider
1B and 1A to become 4B, 4A
2B and 2A to become 5B, 5A
3B and 3A to become 6B, 6A
Refer to sheets which are with memory.
Then connect Pin 8 of
4B and 4A together,
5B and 5A together,
6B and 6A together.
Then connect pair 4B, 4A by Pin 8 to Pin 11 of 74LS138.
Then connect pair 5B, 5A by Pin 8 to Pin 10 of 74LS138.
Then connect pair 6B, 6A by Pin 8 to Pin 9 of 74LS138.

This configuration draws 600 ma, therefore the ZX80 draws 1 amp total. A new power supply must be used.

The ZX80 can run down to 6 volts, so that the existing regulator can be used. It might help to enlarge the area of the heatsink on the regulator by glueing an additional aluminium fin to the heatsink.

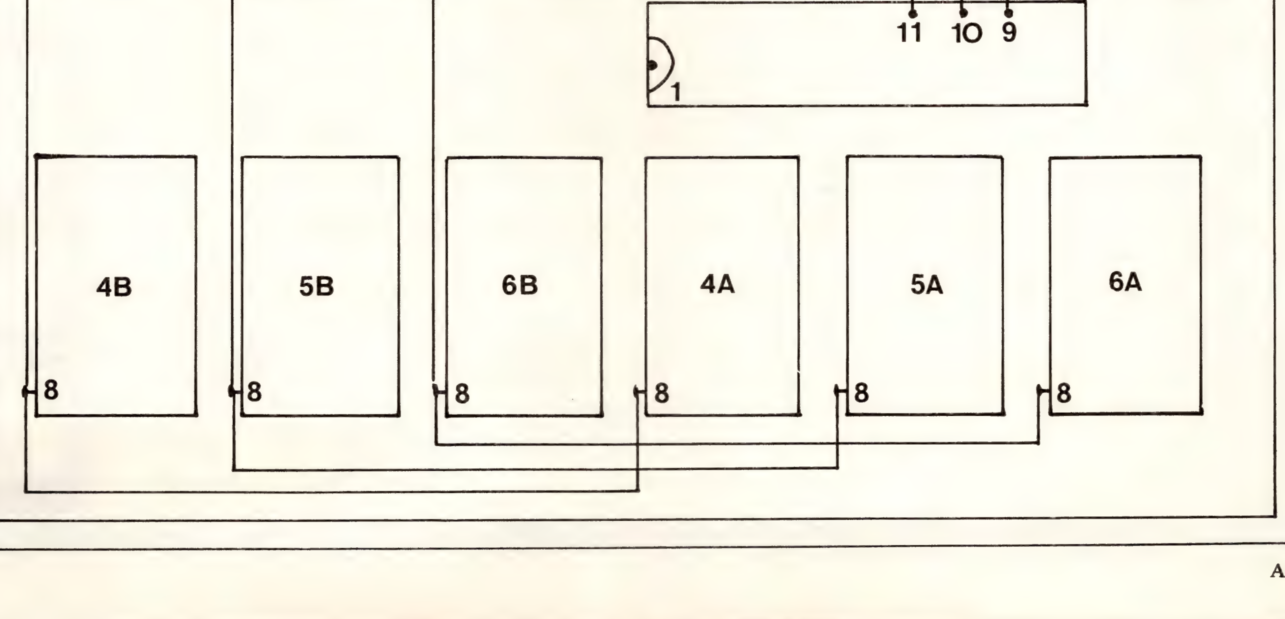
For an extra 1k which will cost you about $10.00 –
Place 2 x MM2114N's, one on 4A and one on 4B, to give 7A, 7B and connect both Pin 8s together, and connect to Pin 7 of 74LS138. If you have a 3k expansion kit and only have 1 or 2k, by buying MM2114N at approx. $5.00 each, you save $5.00 per chip. Radio Parts stock MMS114N at 200 nanoseconds. Now you have 7 or 8k of RAM for about $30.00 more. If when connecting expansion RAM, no K symbol comes up, check for shorts in piggyback connections.

We haven't tried it ourselves but Mr Ernst's photographs make it look easy.

For further information about the Club just write sending a stamped self-addressed envelope to

NATIONAL ZX80 USERS CLUB
24 PEEL STREET
COLLINGWOOD 3066
VICTORIA

for a FREE introductory Newsletter – ZEBRA 80. The newsletter provides Sinclair ZX80 Users with programming tips, sample programs, ways of overcoming problems specific to the ZX80, reviews of currently available software and discussions of developments in the UK and USA. Zebra X-Ray 80 will also serve as a forum for ZX80 Users who will be able to air their views, questions, complaints and any other comments on the ZX80.



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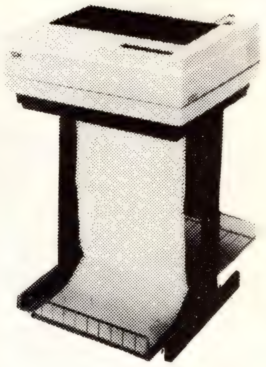

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Solar System Simulation with or without an APPLE II

by David A. Partyka

Here is a fascinating program which combines the graphics of the Apple with the Laws of the Universe to make a super demonstration.

There are unlimited things to do with a micro that has high resolution graphics. Some of the more fascinating aspects are the simulation of objects around us. This article and program deals with the simulated motion of the first six planets of our solar system.

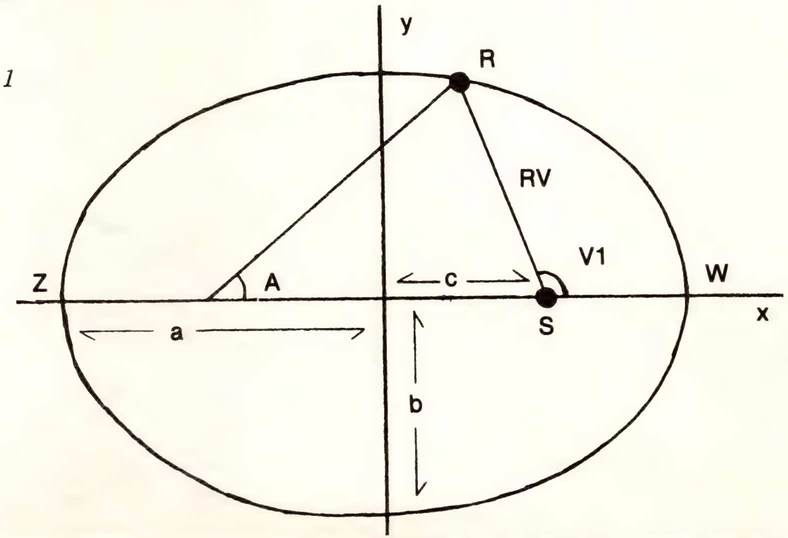
Each planet moves in an elliptical orbit of varying distance from the sun. The closer the orbit to the sun, the less time it takes that planet to complete its orbit. Mercury, the closet planet takes 88 days, while Saturn the farthest of the six takes 29 years. Because the planets move in elliptical orbits, their distance from the sun and orbital speed is constantly changing. Using Johann Kepler's (1571,1630) second law of planetary motion "The line joining the planet to the sun sweeps out equal areas in equal time," we can calculate the time it takes the planet to travel from point W to point R (figure 1). As can be seen, the line RV joining the sun S to the planet R will vary in length as the planet travels around its orbit. Being at its minimum distance at W, the planet must travel faster for the line RV to sweep an equal area as when the planet is at its maximum distance Z.

To calculate the area SWR (figure 1) we use the formula

1.) $\text{Area} = \frac{ab}{2}.(\text{H-e sin H})$.

Variable *a* being the length of the major axis, *b* the length of the minor axis, *e* the eccentricity of the ellipse *(c/a)* and H (figure 2), the angle in RADIANS from the center of the ellipse to point *q*. Point *q* being on a circle of radius *a*, intercepted by a perpendicular line form the major axis going through point R to the circle.

Figure 1



By using Equation (1), we can calculate the number of days it takes the planet to travel any degree of angle from the area of the ellipse, (total area = pi ab), by the number of days to complete the orbit we have the area swept out per day. Rearranging equation (1), we get

2). $\text{H-e sin H} = \frac{\text{area * 2}}{\text{ab}}$

and a problem. The term H-e sin H can't be simplified for the angle H because of the term sin H. Given the daily area we could still calculate the angle H by using a loop routine until we got the correct answer, but this would considerably slow the simulation down.

Instead I use the angle A (figure 1) at the other focus of the ellipse. By dividing 360 degrees by the number of days to complete the orbit we get the number of degrees per day for angle A. Using the equation

3). $\text{RV} = 2 - (\text{P/I} + \text{e} (\cos(180 - \text{A})))$

we get the distance between the sun and the planet for each value of A. Using another equation

4). $\cos \text{V1} = \frac{\text{P} - \text{RV}}{\text{RV*e}}$

we get the angle V1 that the planet lies in relation to the sun (figure 2). The value in P in equation (4) being a perpendicular line from the focus to the ellipse and equal to $a(L\text{-}e^2)$. By increasing angle A at the daily rate we get the X,Y coordinates for each day and plot it on the screen.

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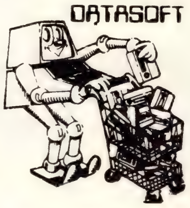

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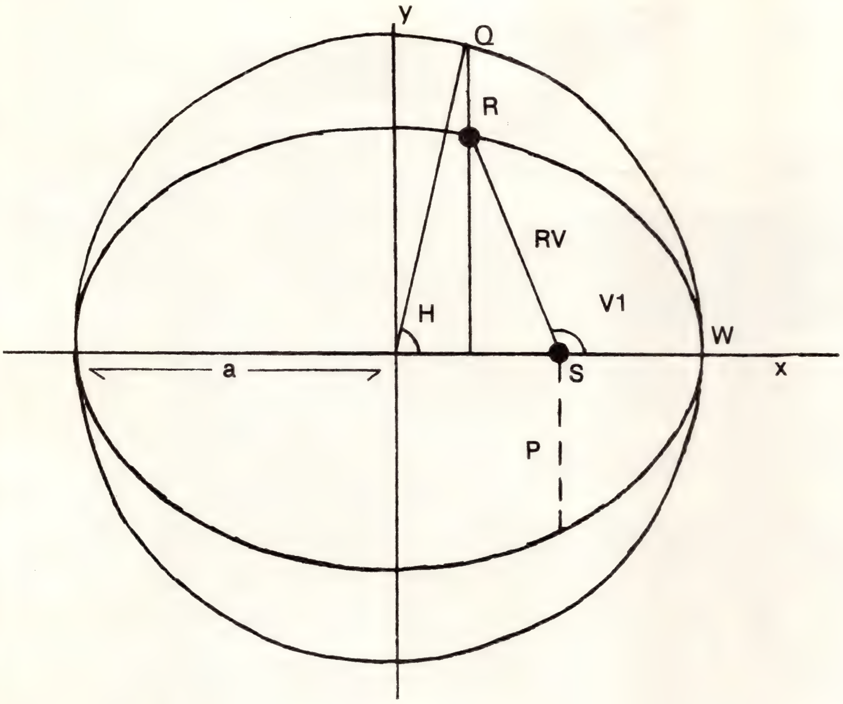


Figure 2

Using angle A also causes a problem. Increasing angle A at a daily rate doesn't increase the area SWR (figure 1) at a daily rate. Even though there is an error, it isn't accumulative. The difference returns to zero at four points in the orbit, two points being at the minimum point W and the maximum point Z. The other two points vary with eccentricity but zero out before the ¼ position and after the ¾ position of its orbit. For Mercury, the fastest planet the error amounts to about .65 degrees and even less for the other planets. One more equation,

5). $\cos H = \frac{a-RV}{ae}$

is a link between equation (1) and equation (3) and can be used to calculate the error of using angle A.

Now that the calculations are out of the way, let me describe the program. To keep the program small I chose only the first six planets. If you want to add the other three planets it can be done with little trouble, see Listing 1. The planets are plotted in order from the sun, Mercury, Venus, Earth, Mars, Jupiter, then Saturn. You can choose any combination of planets to display, from one to all six. The planets are assigned scaling factors so its orbit will use the full plotting area when selected planets are used.

You can plot the position of the planets or planet for any day, i.e. July 8, 1980, or for any length of time from when you choose, i.e., 100 days starting at Oct 3, 1980. You can plot any length of time with any amount of time between plots, i.e., plot 900 days with 30 days between plots. Then you can choose whether to plot single points, only one dot per planet or continuous plots, each dot remains on the screen. Using single point plots it appears as if you are above the solar system looking down on the planets as they orbit the sun. With continuous plots you can see the orbit for the length of time you choose to plot with the amount of time between plots. When doing a plot, the first plot is always the date you choose, then it continues with what you requested. Figure 3 is an example of plotting all the planets for Aug 11, 1980, 0 was the response of the number of days to plot with any number for days between plots. The constellation names, planet names, and degrees don't show on the actual display but are shown here for reference.

Figure 4 is an example of plotting the planets Mercury, Venus, and the Earth on May 29, 1980 for 44 days with 4 days between plots. In this example May 29th was the first plot followed by the 11 plots for 44 days at 4 day intervals. Around the plotting area is a circle that has plots at 10 degree intervals with a double plot at the zero point. Use this to get the longitude of degrees that the planet lies in relation to the sun.

This program is set up for Jan. 0, 1980 or if you prefer Dec. 31, 1979. To change the reference date, just add the number of days difference from Jan. 0, 1980 to the values W, i.e., W1, W2, W3, etc.

Some of the things you can do with this program are to determine the dates of superior conjunction, inferior conjunction, opposition, and greatest elongation. You can demonstrate the retrograde motion of the outer planets, whether a planet is a morning or evening object, or when two or more planets will appear close to each other in the sky. What else you can do depends on your knowledge of Astronomy, the program is simple so any additions or changes you make should be easy.

This program is written in floating point Basic and uses the high resolution graphics subroutines. Since there are different types of Apples, those with integer Basic and others with floating Basic in ROM, how you use this program will depend on your system. Since I know my system I will describe what I had to do to it too.

I have a 32k Apple II with integer Basic in ROM. My floating point Basic is on cassette and loads from hex 800 to 29FF. My high resolution subroutines are also on cassette and load from

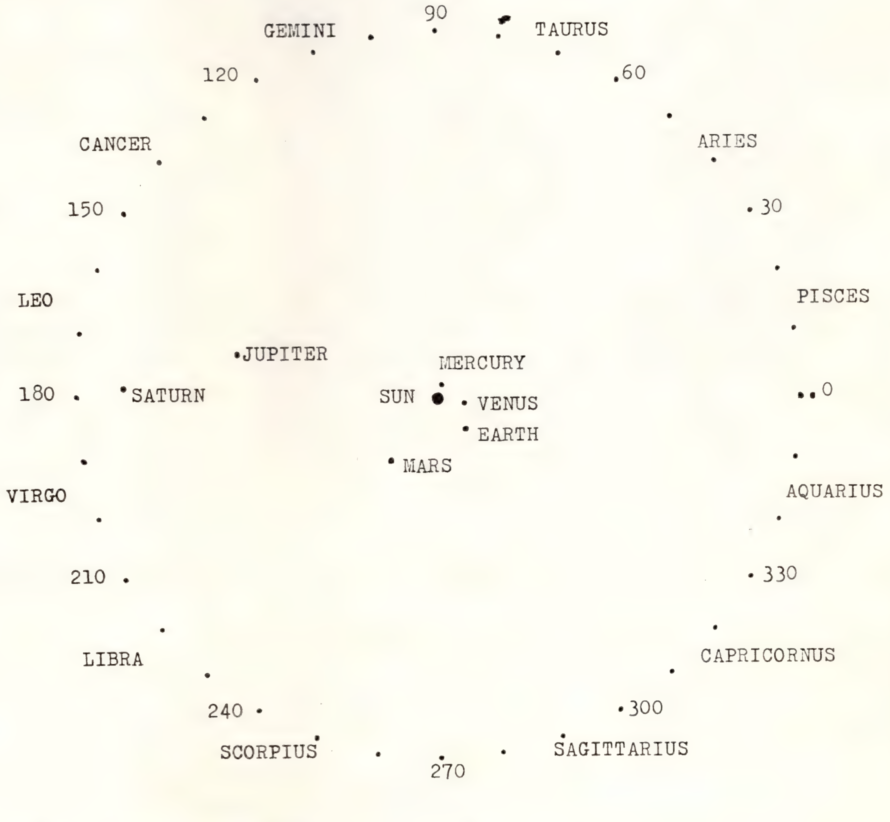
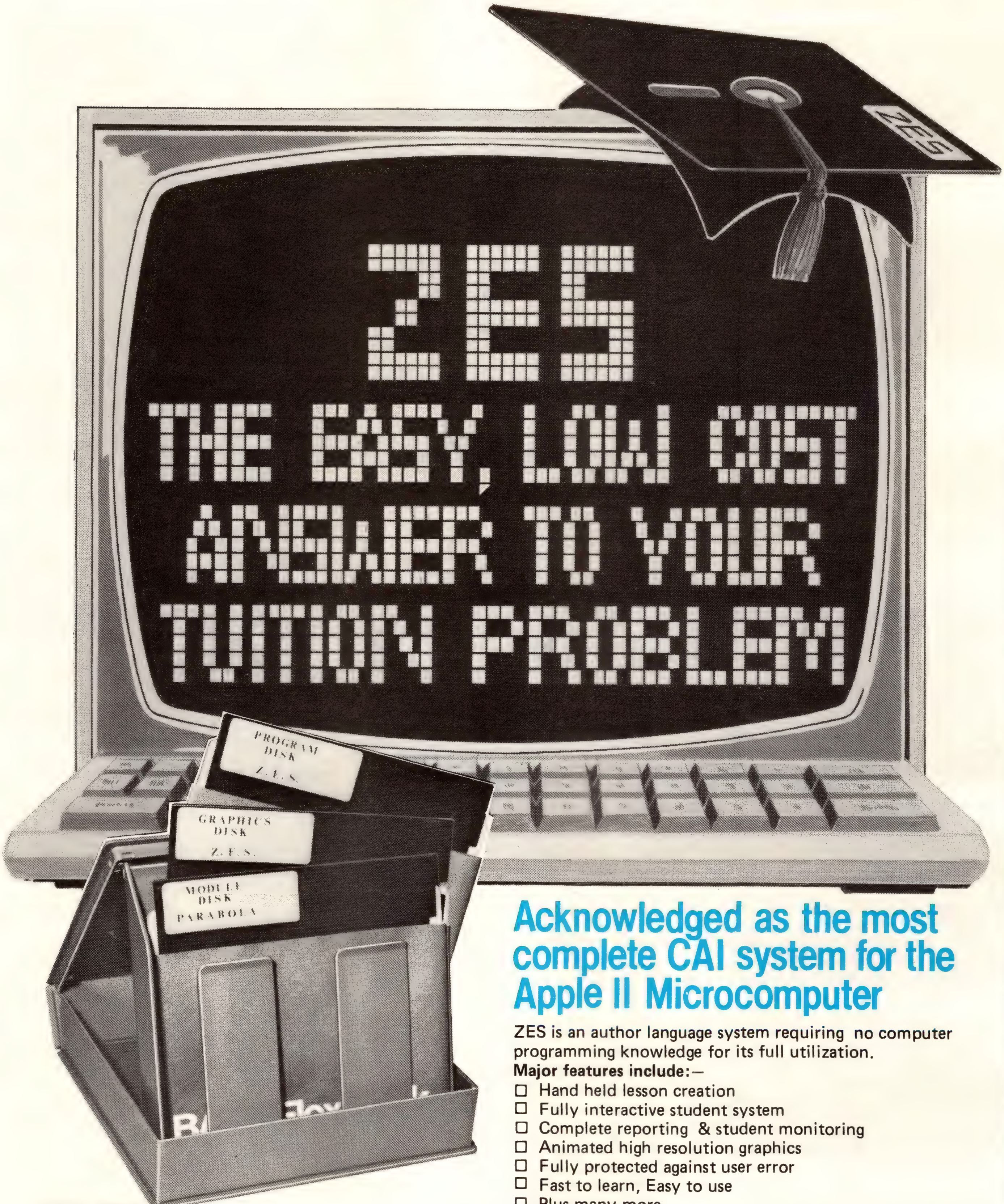


Figure 3: This is an example of the display for all six planets for Aug 11, 1980 (224 days from Jan 0).



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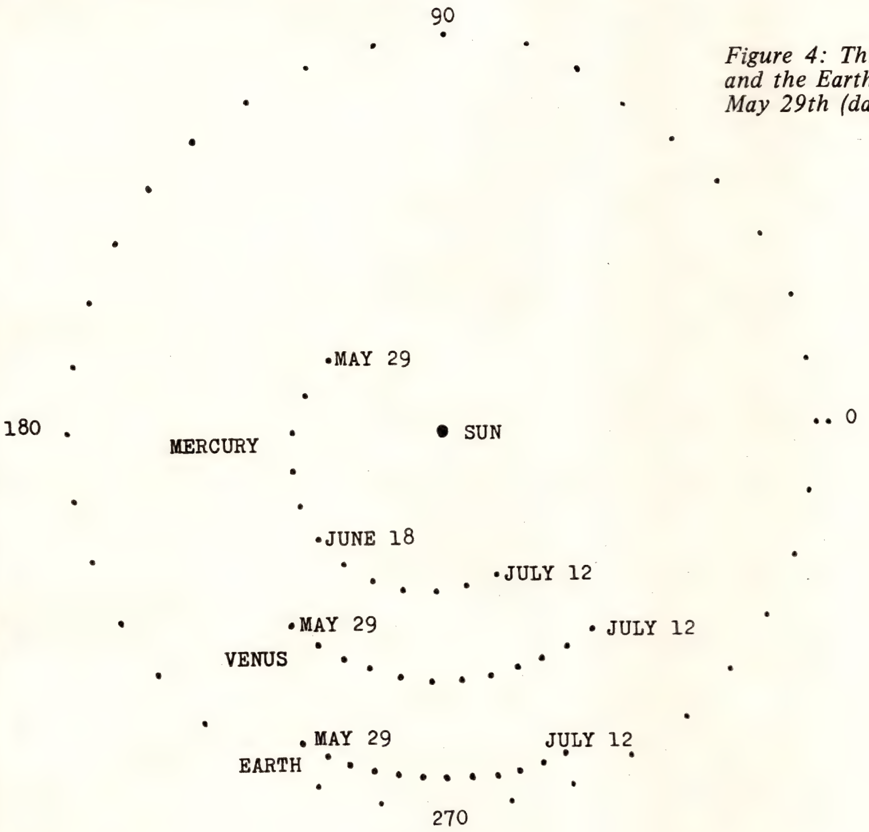


Figure 4: This is a display of the planets Mercury, Venus, and the Earth. This example is for continuous plots starting May 29th (day 150), for 44 days with 4 days between plots

hex C000 to FFF. Page 1 display for high res graphics hex 2000-4000 overlaps my floating point Basic, so I have to use page 2 hex 4000-6000 for the display. Since floating point programs start loading at hex 2A00, large programs will overlap my page 2 display area so I had to change from 2A00 to 6000. This is just beyond the page 2 display area.

On my system, after floating point basic is up and running I have to get into monitor and change hex locations 6B, 6D, 6F, 71 and 2A to 60. Then I have to change three bytes starting at hex 6000 to zeros, (*60000:00 00 00). Some floating point basics load from hex 800 to 2FFF. If this is yours then change hex locations 67 and 68, (*67:01 60). Then put zeros in the three bytes starting at 6000 like above. Typing OG then RETURN should get you back to floating point Basic but don't do it yet. The high res subroutines also overlap the floating point Basic, so I had to make changes there and load it in the area hex 3C00 to 3FFF. See Listing 2 for those changes. Now that I made all the changes to monitor, OG RETURN gets me back to floating point Basic where I load the program as usual. The first time I did this I was surprised it worked, but it did. I hope the configuration of your system will allow you to use this program without moving things around, but if you do these changes are easier than it looks. Saving the new high res subroutines on tape or disk will speed things up the next time you have to do this.

If you're wondering how accurate this program is, I used an almanac for 1980 that gave the dates of special events for the planets, and all 20 dates that I tried worked. The display that I got for each date corresponded to what the almanac said was happening. I also have a book that gives the location of the planets 22 years ago, and the display I got was accurate enough not to make changes to the program.

This program can still be used on micros without high res graphics. The plotting routines can be changed to print the values RV, V1, and the X, Y positions. The distances between the Earth and other planets can also be calculated.

One last word about the display. Using Figure 4 and the July 12th date, a line drawn from the Earth through the planet Venus to the 10 degree circle intersects at about 47 degrees. This doesn't correspond to where Venus appears in the sky. Since the 10 degree circle doesn't have an infinite radius and is centered on the Sun and not the Earth, a line from the Sun parallal to the first should be drawn. This intersects the 10 degree circle at about 76 degrees. Looking at Figure 3, 76 degrees is in the constellation Taurus, and corresponds to where Venus should appear on July 12th.

	Sidereal revolution in days	Distance from Sun in million miles max.	min.	Longitude of perhelion in degrees	Eccentricity
Mercury	87.969	43.403	28.597	77.1	.2056
Venus	224.701	67.726	66.813	131.3	.0068
Earth	365.256	94.555	91.445	102.6	.0167
Mars	686.980	154.936	128.471	335.7	.0934
Jupiter	4332.125	507.046	460.595	13.6	.0478
Saturn	10825.863	937.541	838.425	95.5	.0555
Uranus	30676.15	1859.748	1699.331	172.9	.0503
Neptune	59911.13	2821.686	2760.386	58.5	.0066
Pluto	90824.2	4551.386	2756.427	223.0	.2548

Listing 1.

ADDRESS	OLD	NEW
C01	20	40
C65	0B	3B
C7E	0C	3C
CE3	0D	3D
D0A	0D	3D
D62	0D	3D
D6B	0D	3D
D93	0D	3D
D9F	0D	3D
DCD	0E	3E
DD5	0E	3E
DF6	0D	3D
E02	0D	3D
E3D	0D	3D
EBF	0C	3C
EC6	0E	3E
EC9	0C	3C
ED8	0C	3C
EF1	0D	3D

From monitor load the high res subroutines in the normal location, C00 to FFF. Make these changes then move the subroutines to 3C00 by keying 3C00<C00.FFFM then RETURN.

The value in location C01 was changed to use page 2 (4000-6000) instead of page 1 (2000-4000).

OLD VALUES DEC.	HEX.	HIGH-RES COMMANDS	NEW VALUES DEC.	HEX.
3072	C00	INIT	15360	3C00
3086	C0E	CLEAR	15374	3C0E
3780	EC4	PLOT	16068	3EC4
3761	EB1	POSN	16049	3EB1
3786	ECA	LINE	16074	3ECA
3805	EDD	SHAPE	16093	3EDD

Listing 2.

```
1    REM SOLAR SYSTEM SIMULATION FOR THE APPLE II
2    REM WRITTEN BY  DAVE A. PARTYKA
3    REM             1707 N. NANTUCKETT DR.
4    REM             LORAIN, OHIO  44053
5    REM WRITTEN FEB. 1980
10   GOTO 1000
90   REM (100-110) POKE X AND Y VALUES FOR PLOTTING
100  POKE 800,X-INT(X/256)*256:POKE 801,INT(X/256)
110  POKE 802,Y:L=USR(16068):RETURN
150  REM (200-300) CALCULATE THE X AND Y PLANET POSITIONS
200  D=Z-INT(Z/SRD)*SRD
205  REM D IS FOR DAYS
210  B=Q-(D/SRD*Q2)
220  RV=A-(P/(1+E*COS(B)))
225  REM RV IS THE RADIUS VECTOR OR DISTANCE FROM
          THE SUN TO THE PLANET
230  V=PE/RV-EZ
240  IF V=>1 THEN V=VL
245  IF V=<-1 THEN V=-VL
250  V1 =-ATN(V/SQR(-V*V+1))+T
255  REM V1 IS THE ANGLE THAT THE PLANET
     LIES FROM THE SUN. THE 0 POINT BEING AT
     THE RIGHT, INCREASING COUNTER CLOCKWISE.
260  IF D SRD/2 THEN V1=Q2-V1
270  V1=V1+J
280  X=COS(V1)*RV:Y=-SIN(V1)*RV*FA
290  X=X*TT+X1:Y=Y*TT+Y1
300  RETURN
900  REM (1000) DISPLAY PRIMARY PAGE, SET TEXT MODE
1000 POKE-16300,0:POKE-16303,0
1010 T=1.5708
1020 Q=3.14159265
1030 Q2=6.2831853
1040 VL=.99999999
1050 FA=29/32
1055 REM FA IS THE RATIO OF X TO Y TO PLOT A CIRCLE
     ON THE APPLE INSTEAD OF AN OVAL
1060 X1=140:Y1=96
1700 PRINT:PRINT:PRINT:PRINT:PRINT
1800 PRINT "DO YOU WANT TO DISPLAY "
1810 PRINT:PRINT "THE SAME PLANETS AS YOUR LAST RUN"
1815 PRINT:INPUT "Y OR N ";A$
1820 PRINT:PRINT
1830 IF A$="N" THEN 2000
1840 IF A$<>"Y" THEN 1800
1850 IF S1<>0 THEN 4000
1855 PRINT:PRINT
1860 PRINT:PRINT "YOU HAV'NT PICKED THE PLANETS YET"
1870 PRINT:PRINT:PRINT
2000 PRINT "CHOOSE THE PLANETS YOU WANT TO DISPLAY"
2005 PRINT
2010 PRINT "ENTER A 1 FOR YES, 0 FOR NO"
2011 PRINT
2012 REM (2020-2079) GET SPECIFIC VALUES FOR EACH PLANET
2013 REM S1=ORBITAL PERIOD: P1=A1*(1-E1*E1)/2
2014 REM E1=ECCENTRICITY: U1=P1/E1: K1=1/E1
2015 REM A1=MINIMUM + MAXIMUM DISTANCE FROM SUN
2016 REM J1=LONGITUDE OF PERIHELION IN RADIANS
2017 REM W1=DAYS FROM 0 DEGREES TO PERIHELION FOR 1980
2018 REM TT=SCALING FACTOR TO USE FULL PLOTTING AREA
     IF SELECTED PLANETS ARE DISPLAYED.
2020 INPUT "DISPLAY MERCURY     ";ME
2021 S1=87.969
2022 E1=.2056
2023 A1=43.403+28.597
2024 P1=A1*(1-E1*E1)/2
2025 K1=1/E1
2026 U1=P1/E1
2027 J1=77.1*Q/180
2028 W1=37.58
2029 IF ME=1 THEN TT=2.3
2030 INPUT "DISPLAY VENUS       ";VE
2031 S2=224.701
2032 E2=.0068
2033 A2=67.726+66.813
2034 P2=A2*(1-E2*E2)/2
2035 K2=1/E2
2036 U2=P2/E2
2037 J2=131.3*Q/180
2038 W2=140.5
2039 IF VE=1 THEN TT=1.5
2040 INPUT "DISPLAY EARTH       ";EA
2041 S3=365.256
2042 E3=.0167
2043 A3=94.555+91.445
2044 P3=A3*(1-E3*E3)/2
2045 K3=1/E3
2046 U3=P3/E3
2047 J3=102.6*Q/180
2048 W3=-3
2049 IF EA=1 THEN TT=1.05
2050 INPUT "DISPLAY MARS        ";MA
2051 S4=686.980
2052 E4=.0934
2053 A4=154.936+128.471
2054 P4=A4*(1-E4*E4)/2
2055 K4=1/E4
2056 U4=P4/E4
2057 J4=335.7*Q/180
2058 W4=289
2059 IF MA=1 THEN TT=.6
2060 INPUT "DISPLAY JUPITER     ";JU
2061 S5=4332.125
2062 E5=.0478
2063 A5=507.046+460.595
2064 P5=A5*(1-E5*E5)/2
2065 K5=1/E5
2066 U5=P5/E5
2067 J5=13.6*Q/180
2068 W5=1604
2069 IF JU=1 THEN TT=.19
2070 INPUT "DISPLAY SATURN      ";SA
2071 S6=10825.863
2072 E6=.0555
2073 A6=937.541+838.425
2074 P6=A6*(1-E6*E6)/2
2075 K6=1/E6
2076 U6=P6/E6
2077 J6=95.5*Q/180
2078 W6=2115
2079 IF SA=1 then TT=.1
3900 PRINT:PRINT:PRINT
4000 PRINT:PRINT "DO YOU WANT":PRINT
4010 INPUT "POINT (0) OR CONTINUOUS (1) PLOTS ";TY
4015 IF TY <> 0 AND TY <> 1 THEN 4000
4020 PRINT:PRINT:PRINT
4030 PRINT:PRINT "DO YOU WANT TO START AT":PRINT
4040 PRINT "A SPECIFIC DATE (0) ":PRINT
4050 INPUT "OR THE BEGINNING OF THE YEAR (1) ";DT
4051 IF DT<>0 AND DT<>1 THEN 4020
4052 IF DT=1 THEN 4060
4053 PRINT:PRINT:PRINT
4054 INPUT "ENTER # OF DAYS SINCE JAN 0 1980 ";DE
4057 Z1=DE
4060 PRINT:PRINT:INPUT "ENTER # OF DAYS TO PLOT ";DN
4070 PRINT:PRINT:PRINT
4080 INPUT "ENTER # OF DAYS BETWEEN PLOTS ";DA
4082 IF DA<>0 THEN 4800
4084 PRINT:PRINT
4086 PRINT "0 NOT ALLOWED:GOTO 4070
4090 REM (4800) INIT HIGH RES, FULL SCREEN, PAGE 2
4800 L=USR(15360):POKE-16302,0:POKE-16299,0
4802 REM (4805-4860) PLOT REFERENCE POINTS AND OUTER
     10 DEGREE CIRCLE
4805 POKE 812,255
4810 X=140:Y=96:GOSUB 100
4811 X=141:Y=96:GOSUB 100
4815 X=248:Y=96:GOSUB 100
4820 FOR L1=0TOQ2STEP1/36*Q2
4830 X=X1+COS(L1)*105.9
4840 Y=Y1-SIN(L1)*105.9*FA
4850 GOSUB 100
4860 NEXT L1
4900 REM (5100-5140) SET UP VALUES FOR MERCURY AND PLOT
5100 IF ME=0 THEN 5200
5110 A=A1:P=P1:E=E1:PE=U1:EZ=K1:SRD=S1:J=J1:W=W1:Z=Z1+W
5120 GOSUB 200:F1=X:G1=Y
5125 IF TY=1 THEN 5140
5130 X=M1:Y=N1:POKE812,0:GOSUB 100
5140 X=F1:Y=G1:M1=X:N1=Y:POKE812,255:GOSUB 100
5190 REM (5200-5240) SET UP VALUES FOR VENUS AND PLOT
5200 IF VE=0 THEN 5300
5210 A=A2:P=P2:E=E2:PE=U2:EZ=K2:SRD=S2:J=J2:W=W2:Z=Z1+W
5220 GOSUB 200:F2=X:G2=Y
5225 IF TY=1 THEN 5240
5230 X=M2:Y=N2:POKE812,0:GOSUB 100
5240 X=F2:Y=G2:M2=X:N2=Y:POKE812,255:GOSUB 100
5290 REM (5300-5340) SET UP VALUES FOR EARTH AND PLOT
5300 IF EA=0 THEN 5400
5310 A=A3:P=P3:E=E3:PE=U3:EZ=K3:SRD=S3:J=J3:W=W3:Z=Z1+W
5320 GOSUB 200:F3=X:G3=Y
5325 IF TY=1 THEN 5340
5330 X=M3:Y=N3:POKE812,0:GOSUB 100
5340 X=F3:Y=G3:M3=X:N3=Y:POKE812,255:GOSUB 100
5390 REM (5400-5440) SET UP VALUES FOR MARS AND PLOT
5400 IF MA=0 THEN 5500
5410 A=A4:P=P4:E=E4:PE=U4:EZ=K4:SRD=S4:J=J4:W=W4:Z=Z1+W
5420 GOSUB 200:F4=X:G4=Y
5425 IF TY=1 THEN 5440
5430 X=M4:Y=N4:POKE812,0:GOSUB 100
5440 X=F4:Y=G4:M4=X:N4=Y:POKE812,255:GOSUB 100
5490 REM (5500-5540) SET UP VALUES FOR JUPITER AND PLOT
5500 IF JU=0 THEN 5600
5510 A=A5:P=P5:E=E5:PE=U5:EZ=K5:SRD=S5:J=J5:W=W5:Z=Z1+W
5520 GOSUB 200:F5=X:G5=Y
5525 IF TY=1 THEN 5540
5530 X=M5:Y=N5:POKE812,0:GOSUB 100
5540 X=F5:Y=G5:M5=X:N5=Y:POKE812,255:GOSUB 100
5590 REM (5600-5640) SET UP VALUES FOR SATURN AND PLOT
5600 IF SA=0 THEN 6000
5610 A=A6:P=P6:E=E6:PE=U6:EZ=K6:SRD=S6:J=J6:W=W6:Z=Z1+W
5620 GOSUB 200:F6=X:G6=Y
5625 IF TY=1 THEN 5640
5630 X=M6:Y=N6:POKE812,0:GOSUB 100
5640 X=F6:Y=G6:M6=X:N6=Y:POKE812,255:GOSUB 100
6000 Z1=Z1+DA
6100 IF Z1>DE+DN THEN 7000
6200 GOTO 5100
7000 X=279:Y=190:GOSUB 100:INPUTA$
7050 REM (7000) PLOT POINT 297 190 TO INDICATE END OF
     SIMULATION THEN WAIT FOR INPUT OF ANY CHARACTER
     TO START AGAIN.
7100 Z1=0:DE=0
7200 GOTO 1000
```

"The headmaster's very keen on new technology, but he still believes in the good old fashioned virtues of outdoor sport."

Drawing A Line On PET's 80 x 50 Grid

by Harvey S. Davis

A collection of flexible, machine language routines. Allows plotting of individual points – or lines between points – using PET's quarter-box graphic characters. Additional features include erasing and screen inversion.

The purpose of this article is to provide some machine language subroutines, which can be called from Basic, that will enable the user of a PET personal computer to draw either a point or a line on the screen, at double the resolution of the ordinary screen grid. The point or line drawn may be either plotted or erased.

An interesting feature of these subroutines is that the graphics are drawn on the screen between successive hardware updates of the screen. This means that the "snow" that results when the PET competes with the character generator video RAM will not be present.

The reader should note that these subroutines are designed for use on a PET with the original ROMs. Extensive use is made of the Basic input buffer for zero page storage. These variables would have to be relocated. Also there are calls to $E840 to determine the status of the update of the screen.

Display grids

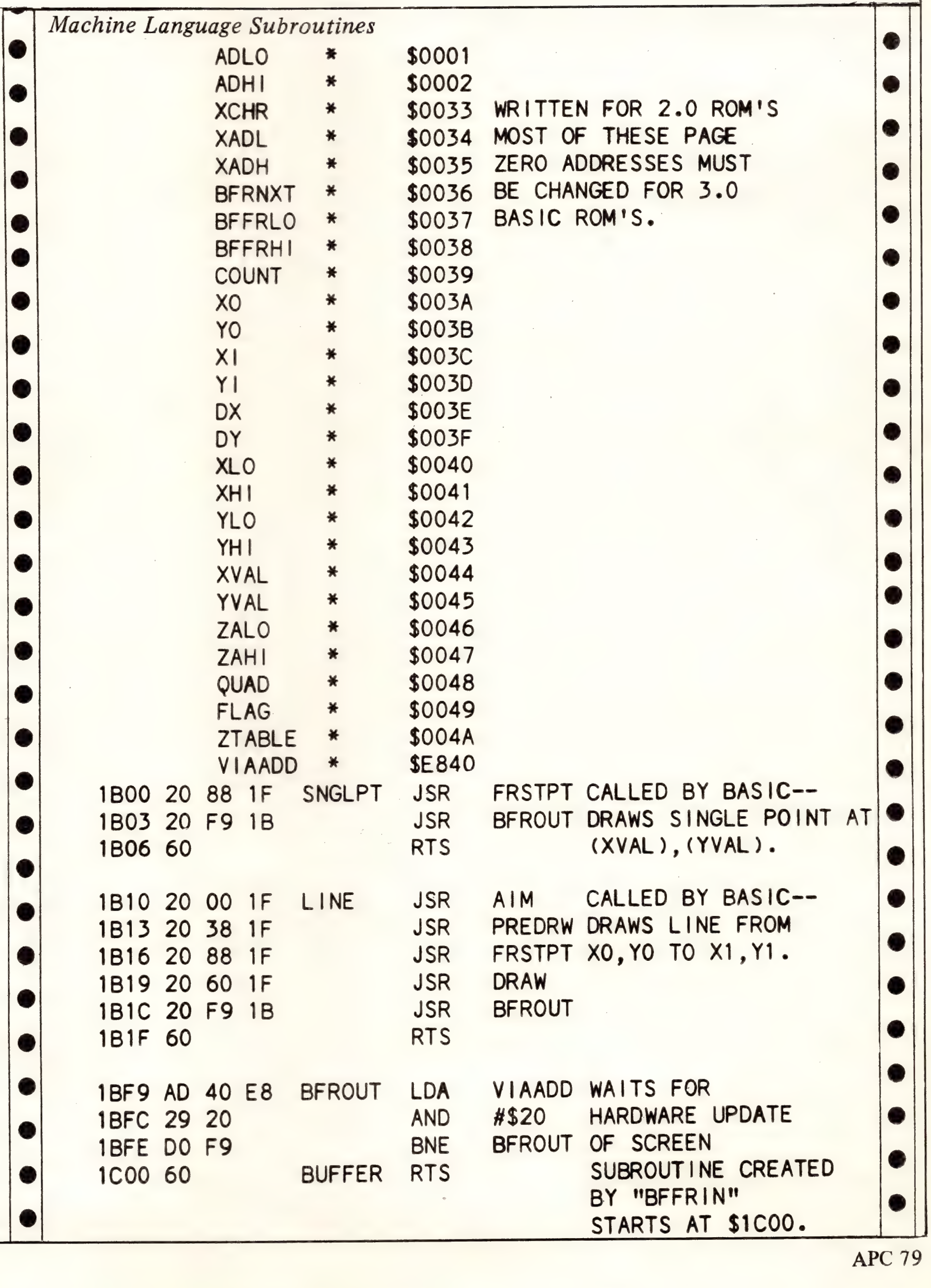
The PET displays characters on its screen with reference to a 25 x 40 grid. Each screen location is associated with an address in memory, according to the following formula:

ADDRESS=32* 1024 + 25*Y + X

X denotes the column $(0 \leq X \leq 39)$ and Y denotes the row $(0 \leq Y \leq 24)$. The positive x-axis points to the left, while the positive y-axis points down. Thus address 32*1024 is associated with the upper left-hand corner of the screen. I will refer to these conventions as the "screen grid".

In order to discuss the generation of graphics having twice the resolution of the screen grid, I shall use two other grids which I shall call the observer's grids.

The observer's grid positive down is an 80 x 50 grid $(0 \leq X \leq 79,\ 0 \leq Y \leq 49)$ with the origin in the upper left hand corner, the x-axis proceeding from left



Machine Language Subroutines

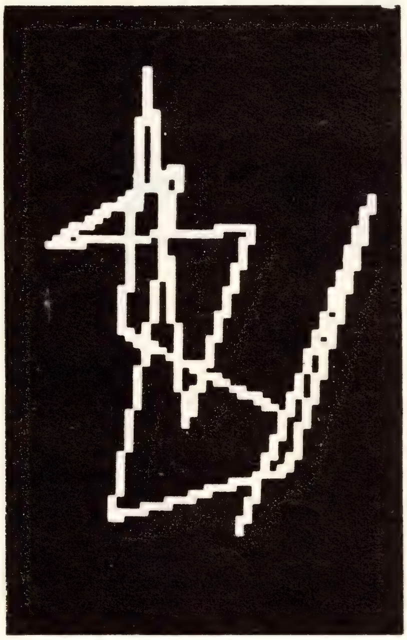
```
               ADLO     *     $0001
               ADHI     *     $0002
               XCHR     *     $0033  WRITTEN FOR 2.0 ROM'S
               XADL     *     $0034  MOST OF THESE PAGE
               XADH     *     $0035  ZERO ADDRESSES MUST
               BFRNXT   *     $0036  BE CHANGED FOR 3.0
               BFFRLO   *     $0037  BASIC ROM'S.
               BFFRHI   *     $0038
               COUNT    *     $0039
               XO       *     $003A
               YO       *     $003B
               XI       *     $003C
               YI       *     $003D
               DX       *     $003E
               DY       *     $003F
               XLO      *     $0040
               XHI      *     $0041
               YLO      *     $0042
               YHI      *     $0043
               XVAL     *     $0044
               YVAL     *     $0045
               ZALO     *     $0046
               ZAHI     *     $0047
               QUAD     *     $0048
               FLAG     *     $0049
               ZTABLE   *     $004A
               VIAADD   *     $E840
1B00 20 88 1F  SNGLPT  JSR    FRSTPT CALLED BY BASIC--
1B03 20 F9 1B          JSR    BFROUT DRAWS SINGLE POINT AT
1B06 60                RTS           (XVAL),(YVAL).

1B10 20 00 1F  LINE    JSR    AIM    CALLED BY BASIC--
1B13 20 38 1F          JSR    PREDRW DRAWS LINE FROM
1B16 20 88 1F          JSR    FRSTPT XO,YO TO X1,Y1.
1B19 20 60 1F          JSR    DRAW
1B1C 20 F9 1B          JSR    BFROUT
1B1F 60                RTS

1BF9 AD 40 E8  BFROUT  LDA    VIAADD WAITS FOR
1BFC 29 20             AND    #$20   HARDWARE UPDATE
1BFE D0 F9             BNE    BFROUT OF SCREEN
1C00 60        BUFFER  RTS           SUBROUTINE CREATED
                                     BY "BFFRIN"
                                     STARTS AT $1C00.
```

to right and the *y*-axis proceeding from top to bottom.

The observer's grid positive up is an 80 x 50 grid ($0 \leq X \leq 79, 0 \leq Y \leq 49$) with the origin in the lower left hand corner, the *x*-axis proceeding from left to right and the *y*-axis proceeding from bottom to top.



Character Graphics

The character that is displayed at a given location on the screen is completely determined by the byte value stored at the corresponding address.

Among the characters that the PET makes available are 16 that allow the user effectively to double the resolution simultaneously in each direction. These characters can be visualized as a square with each of its quadrants either blank or lit. Table 1 gives these characters and their byte equivalents.

Table 1

a	b	c	d	value
0	0	0	0	20
0	0	0	1	6C
0	0	1	0	7B
0	0	1	1	62
0	1	0	0	7C
0	1	0	1	E1
0	1	1	0	FF
0	1	1	1	FF

a	b	c	d	value
1	0	0	0	7E
1	0	0	1	7F
1	0	1	0	61
1	0	1	1	Fc
1	1	0	0	E2
1	1	0	1	FB
1	1	1	0	EC
1	1	1	1	AO

(continued)

```
1E00 20         TABLE    =     $20       THIS IS A TABLE OF
1E01 6C                  =     $6C       ALL SIXTEEN POSSIBLE
1E02 7B                  =     $7B       QUARTER-BOX CHAR.'S.
1E03 62                  =     $62
1E04 7C                  =     $7C
1E05 E1                  =     $E1
1E06 FF                  =     $FF
1E07 FE                  =     $FE
1E08 7E                  =     $7E
1E09 7F                  =     $7F
1E0A 61                  =     $61
1E0B FC                  =     $FC
1E0C E2                  =     $E2
1E0D FB                  =     $FB
1E0E EC                  =     $EC
1E0F A0                  =     $A0
1E10 A2 0F      INIT     LDX   #$0F      MOVES ABOVE TABLE
1E12 BD 00 1E   LOAD     LDA   TABLE,X   TO PAGE ZERO
1E15 95 4A               STA   ZTABLE,X  BEGINNING AT
1E17 CA                  DEX             ZTABLE=$004A
1E18 10 F8               BPL   LOAD
1E1A 60         RETURN   RTS
1E1B A5 44      POINT    LDA   XVAL     COMPUTES SCREEN
1E1D 30 FB               BMI   RETURN   ADDRESS AND ENCODES
1E1F C9 50               CMP   #$50     CHARACTER QUADRANT
1E21 10 F7               BPL   RETURN
1E23 A5 45               LDA   YVAL
1E25 30 F3               BMI   RETURN    TESTS FOR XVAL AND
1E27 C9 32               CMP   #$32      YVAL IN RANGE
1E29 10 EF               BPL   RETURN
1E2B 24 49      ORIENT   BIT   FLAG      CHECKS BIT 7 OF FLAG
1E2D 10 07               BPL   PREP      = 0 NO CHANGE
1E2F A9 31               LDA   #$31      =1 YVAL = 49 - YVAL
1E31 38                  SEC
1E32 E5 45               SBC   YVAL
1E34 85 45               STA   YVAL
1E36 18         PREP     CLC             2 * PARITY(YVAL) +
1E37 A5 45               LDA   YVAL      PARITY(XVAL)
1E39 29 01               AND   #$01      TRANSFERRED TO
1E3B 0A                  ASL   A         X REG.
1E3C 85 46               STA   ZALO
1E3E A5 44               LDA   XVAL
1E40 29 01               AND   #$01
1E42 65 46               ADC   ZALO
1E44 AA                  TAX
1E45 A9 10               LDA   #$10     QUAD = 2   (4-XR+1)
1E47 4A         LOOPA    LSR   A
1E48 CA                  DEX
1E49 10 FC               BPL   LOOPA
1E4B 85 48               STA   QUAD
1E4D 46 44               LSR   XVAL     XVAL = INT(XVAL/2)
1E4F 46 45               LSR   YVAL      YVAL = INT(YVAL/2)
1E51 A9 80      LOCAD    LDA   #$80      SET ADLO,ADHI FOR
1E53 85 02               STA   ADHI      SCREEN UPPER LEFT
1E55 A9 00               LDA   #$00      ZALO = 8 * YVAL
1E57 85 01               STA   ADLO
1E59 85 47               STA   ZAHI
1E5B A5 45               LDA   YVAL
1E5D 0A                  ASL   A
1E5E 0A                  ASL   A
1E5F 0A                  ASL   A
1E60 85 46               STA   ZALO      ZAHI,ZALO =
1E62 06 46               ASL   ZALO        4 * ZALO
1E64 26 47               ROL   ZAHI        32 * YVAL
1E66 06 46               ASL   ZALO
1E68 26 47               ROL   ZAHI
1E6A 65 44               ADC   XVAL      ZAHI,ZALO =
1E6C 65 46               ADC   ZALO        ACCUM. + XVAL +
1E6E 85 46               STA   ZALO        ZAHI,ZALO
1E70 90 02               BCC   ADDAD       = 40 * YVAL + XVAL
1E72 E6 47               INC   ZAHI
1E74 18         ADDAD    CLC                + ADHI,ADLO
1E75 A5 46               LDA   ZALO         = $8000 + 40 * YVAL
1E77 65 01               ADC   ADLO         + XVAL
```

```
1E79 85 01              STA  ADLO
1E7B A5 47              LDA  ZAHI
1E7D 65 02              ADC  ADHI
1E7F 85 02              STA  ADHI
1E81 60                 RTS
1E88 AD 40 E8  GETCHR   LDA  VIAADD    WAITS FOR HARDWARE
1E8B 29 20              AND  #$20      SCREEN UPDATE--
1E8D D0 F9              BNE  GETCHR    AVOIDS SNOW!!
1E8F A2 00              LDX  #$00      GET CHARACTER FROM
1E91 A1 01              LDA  (ADLO,X)  SCREEN ADLO,ADHI
1E93 85 33              STA  XCHR      STASH IN XCHR
1E95 A5 01              LDA  ADLO      XADL = ADLO
1E97 85 34              STA  XADL
1E99 A5 02              LDA  ADHI      XADH = ADHI
1E9B 85 35              STA  XADH
1E9D 60                 RTS
1EA0 A5 33     UPDATE   LDA  XCHR       LOOK FOR XCHR IN
1EA2 A2 00              LDX  #$00       ZTABLE
1EA4 D5 4A     LOOPB    CMP  ZTABLE,X
1EA6 F0 06              BEQ  TSTFLG     FOUND
1EA8 E8                 INX
1EA9 E0 10              CPX  #$10       AT END OF TABLE?
1EAB D0 F7              BNE  LOOPB
1EAD 60                 RTS
1EAE 24 49     TSTFLG   BIT  FLAG      TEST FLAG--BIT 6
1EB0 50 0C              BVC  PLOT       =0 PLOT =1 ERASE
1EB2 A9 FF     ERASE    LDA  #$FF      BLANKS QUANDRANT
1EB4 45 48              EOR  QUAD      INDICATED BY
1EB6 85 48              STA  QUAD      (QUAD) OF COVERING
1EB8 8A                 TXA            CHARACTER (SCHR).
1EB9 25 48              AND  QUAD      TABLE INDEX OF NEW
1EBB AA                 TAX            CHAR. NOW IN XR.
1EBC 10 04              BPL  CONT      ACTUALLY UNCOND.!
1EBE 8A        PLOT     TXA            FILLS QUADRANT
1EBF 05 48              ORA  QUAD      INDICATED BY QUAD.
1EC1 AA                 TAX
1EC2 B5 4A     CONT     LDA  ZTABLE,X STORES NEW
1EC4 85 33              STA  XCHR      COVERING CHAR.
1EC6 60                 RTS
1EC8 A9 00     SETBFR   LDA  #$00         ADJUSTS
1ECA 85 36              STA  BFRNXT       BUFFER
1ECC 85 37              STA  BFFRLO       POINTERS
1ECE A9 1C              LDA  #$1C
1ED0 85 38              STA  BFFRHI
1ED2 60                 RTS
1ED8 A4 36     BFRIN    LDY  BFRNXT       BUFFER INDEX
1EDA A9 A9              LDA  #$A9          = "LDA #"
1EDC 91 37              STA  (BFFRLO),Y
1EDE C8                 INY
1EDF A5 33              LDA  XCHR         XCHAR IN NEXT
1EE1 91 37              STA  (BFFRLO),Y BUFFER LOC.
1EE3 C8                 INY
1EE4 A9 8D              LDA  #$8D          = "STA ABS."
1EE6 91 37              STA  (BFFRLO),Y
1EE8 C8                 INY
1EE9 A5 34              LDA  XADL         TRANSFER CALC.
1EEB 91 37              STA  (BFFRLO),Y SCREEN ADDRESS
1EED C8                 INY               TO BUFFER PROG.
1EEE A5 35              LDA  XADH
1EF0 91 37              STA  (BFFRLO),Y
1EF2 C8                 INY
1EF3 A9 60              LDA  #$60          = "RTS"
1EF5 91 37              STA  (BFFRLO),Y BFRNXT POINTS AT
1EF7 84 36              STY  BFRNXT       THIS "RTS".
1EF9 60                 RTS
1F00 A9 80     AIM      LDA  #$80      SETS POSITIVE
1F02 05 49              ORA  FLAG      DOWN
1F04 85 49              STA  FLAG
1F06 A5 3C     CMPXI    LDA  XI        MAKES SURE PLOT
1F08 C5 3A              CMP  X0        PROCEEDS IN
1F0A 10 0E              BPL  CMPYI     POSITIVE X
1F0C A6 3A              LDX  X0        DIRECTION
1F0E 85 3A              STA  X0
1F10 86 3C              STX  XI
```

a	b
c	d

a = 0 if and only if quadrant a is blank

b = 0 if and only if quadrant b is blank

c = 0 if and only if quadrant c is blank

d = 0 if and only if quadrant d is blank

Some notation Conventions

If XXX denotes an address, then [XXX] will denote the byte value stored at that address. [XXX] may also, in the appropriate context, denote the character represented by that byte value.

If XXX and YYY denote addresses, then (XXX,YYY) will denote the address whose low byte is [XXX] and whose high byte is [YYY]. [XXX, YYY] will denote the double precision number whose most significant byte is [XXX] and whose least significant byte is [YYY].

AC, XR, and YR denote the byte values at the accumulator, the *x* register and the *y* register.

BASIC SUBROUTINES (FOR DRAWING A SINGLE POINT AT X, Y ON THE OBSERVER'S GRID)

1. Set the observer's grid positive down. This is done by setting the most significant bit of FLAG = $0049 = 73 to 0.

```
10 POKE 73, PEEK (73) AND 127
: RETURN
```

2. Set the observer's grid positive up. This is done by setting the most significant bit of FLAG = $0049 = 73 to 1.

```
15 POKE 73, PEEK (73) OR 128 :
RETURN
```

3. Set draw mode to PLOT. This is done by setting the second most significant bit of FLAG to 0.

```
20 POKE 73, PEEK (73) AND 191
: RETURN
```

4. Set draw mode to ERASE. This is done by setting the second most significant bit of FLAG to 1.

```
25 POKE 73, PEEK (73) OR 64 :
RETURN
```

5. Draw the point at X, Y. This is done by setting [XVAL] = X, [YVAL] = Y and calling subroutine SNGLPT.

```
30 POKE 68,X : POKE 69, Y : SYS
(6912) : RETURN
```

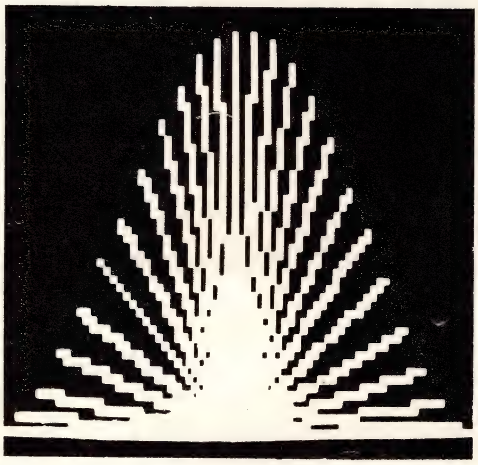
To use the Basic subroutine for drawing a line from X, Y to U, V on the observer's grid positive up, the draw mode may be set by Basic subroutines 20 and 25 above. The drawing is done by setting [XO] = X,[YO] = Y,[X1] = U,[Y1] = V and calling subroutine LINE.

```
40 POKE 58,X : POKE 59,Y :
POKE 60,U : POKE 61,V
42 SYS(6928) : RETURN
```

The user should note that if a Basic program intermixes point and line commands, the orientation of the observer's grid must be reset by either subroutine 10 or 15, before each point command that immediately follows a line command. It need not be reset between successive point commands. The line command (subroutine 40) always assumes that the observer's grid is positive up.

```
1F12 A5 3D           LDA   YI
1F14 A6 3B           LDX   YO
1F16 85 3B           STA   YO
1F18 86 3D           STX   YI
1F1A A5 3D   CMPYI   LDA   YI      MAKES SURE PLOT
1F1C C5 3B           CMP   YO      CALCULATIONS
1F1E 10 12           BPL   RTNAIM  PROCEED IN POSI-
1F20 38              SEC           TIVE Y DIRECTION,
1F21 A9 31           LDA   #$31    IN SPITE OF ACTUAL
1F23 E5 3D           SBC   YI      ORIENTATION.
1F25 85 3D           STA   YI
1F27 38              SEC
1F28 A9 31           LDA   #$31
1F2A E5 3B           SBC   YO
1F2C 85 3B           STA   YO
1F2E 06 49           ASL   FLAG
1F30 46 49           LSR   FLAG
1F32 60      RTNAIM  RTS
1F38 38      PREDRW  SEC           INITIALIZES
1F39 A5 3C           LDA   XI      VARIABLES USED
1F3B E5 3A           SBC   XO      IN LINE
1F3D 85 3E           STA   DX      DRAWING
1F3F 38              SEC

1F40 A5 3D           LDA   YI
1F42 E5 3B           SBC   YO
1F44 85 3F           STA   DY
1F46 A5 3A           LDA   XO
1F48 85 44           STA   XVAL
1F4A 85 41           STA   XHI
1F4C A5 3B           LDA   YO
1F4E 85 45           STA   YVAL
1F50 85 43           STA   YHI
1F52 A2 80           LDX   #$80    PLOTS LINE
1F54 86 40           STX   XLO     FROM XO,YO TO
1F56 86 42           STX   YLO     X1,Y1 BY
1F58 A2 00           LDX   #$00    COMPUTING AND
1F5A 86 39           STX   COUNT   PLOTTING
1F5C 60              RTS           256 CONSECUTIVE
                                   POINTS
1F60 A5 3E   DRAW    LDA   DX
1F62 18              CLC
1F63 65 40           ADC   XLO
1F65 85 40           STA   XLO
1F67 90 02           BCC   INCRY
1F69 E6 41           INC   XHI
1F6B A5 3F   INCRY   LDA   DY      PLOTS POINT AT
1F6D 18              CLC           XVAL,YVAL.
1F6E 65 42           ADC   YLO
1F70 85 42           STA   YLO
1F72 90 02           BCC   CALLPT  INITIALIZE AND
1F74 E6 43           INC   YHI     PLOT FIRST
1F76 A5 41   CALLPT  LDA   XHI     POINT.
1F78 85 44           STA   XVAL    IS THIS ADDRESS
1F7A A5 43           LDA   YHI     SAME AS THAT
1F7C 85 45           STA   YVAL    OF LAST POINT?
1F7E 20 A0 1F        JSR   NEXTPT
1F81 E6 39           INC   COUNT
1F83 D0 DB           BNE   DRAW    END OF BUFFER?
1F85 4C D8 1E        JMP   BFRIN
1F88 20 10 1E FRSTPT JSR   INIT
1F8B 20 1B 1E        JSR   POINT
1F8E 20 88 1E        JSR   GETCHR  BUFFER TO SCREEN
1F91 20 A0 1E        JSR   UPDATE  RESET TO NOMINAL
1F94 20 C8 1E        JSR   SETBFR  LAST CHR. TO BUFF
1F97 20 D8 1E        JSR   BFRIN   CHR. AT NEXT ADDR
1F9A 60              RTS
1FA0 20 1B 1E NEXTPT JSR   POINT
1FA3 A5 01           LDA   ADLO
```

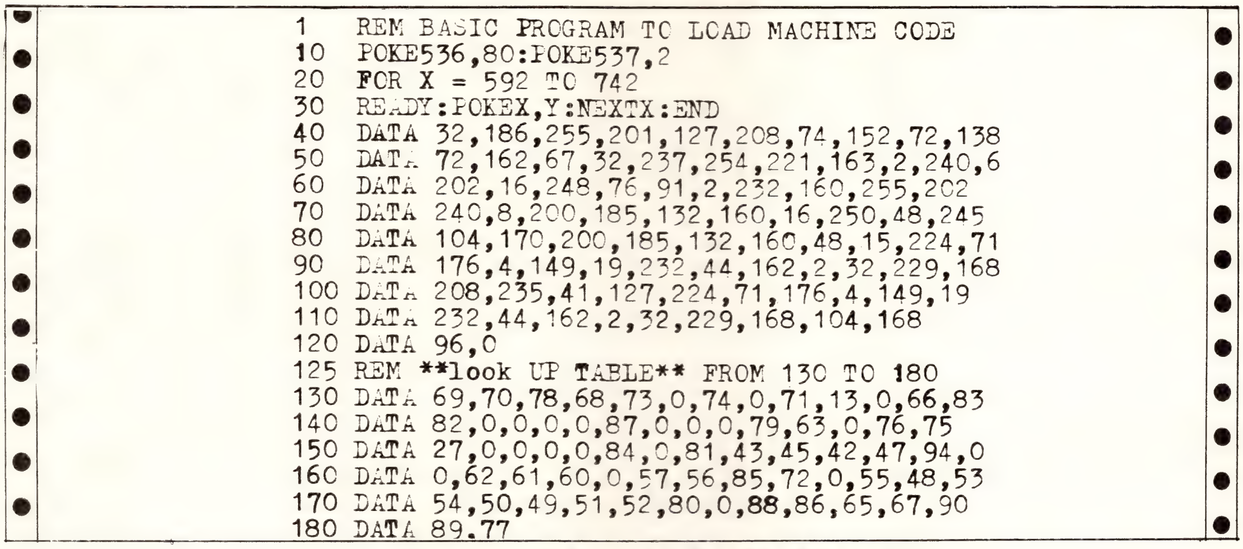


```
1FA5 C5 34                CMP   XADL
1FA7 D0 06                BNE   NEWADR
1FA9 A5 02                LDA   ADHI
1FAB C5 35                CMP   XADH
1FAD F0 13                BEQ   TOUPDT
1FAF A9 F5       NEWADR   LDA   #$F5
1FB1 38                   SEC
1FB2 C5 36                CMP   BFRNXT
1FB4 B0 06                BCS   TOBFFR
1FB6 20 F9 1B             JSR   BFROUT
1FB9 20 C8 1E             JSR   SETBFR
1FBC 20 D8 1E    TOBFFR   JSR   BFRIN
1FBF 20 88 1E             JSR   GETCHR
1FC2 20 A0 1E    TOUPDT   JSR   UPDATE
1FC5 60                   RTS
```

Single Key Keyword Entry For The SUPERBOARD II

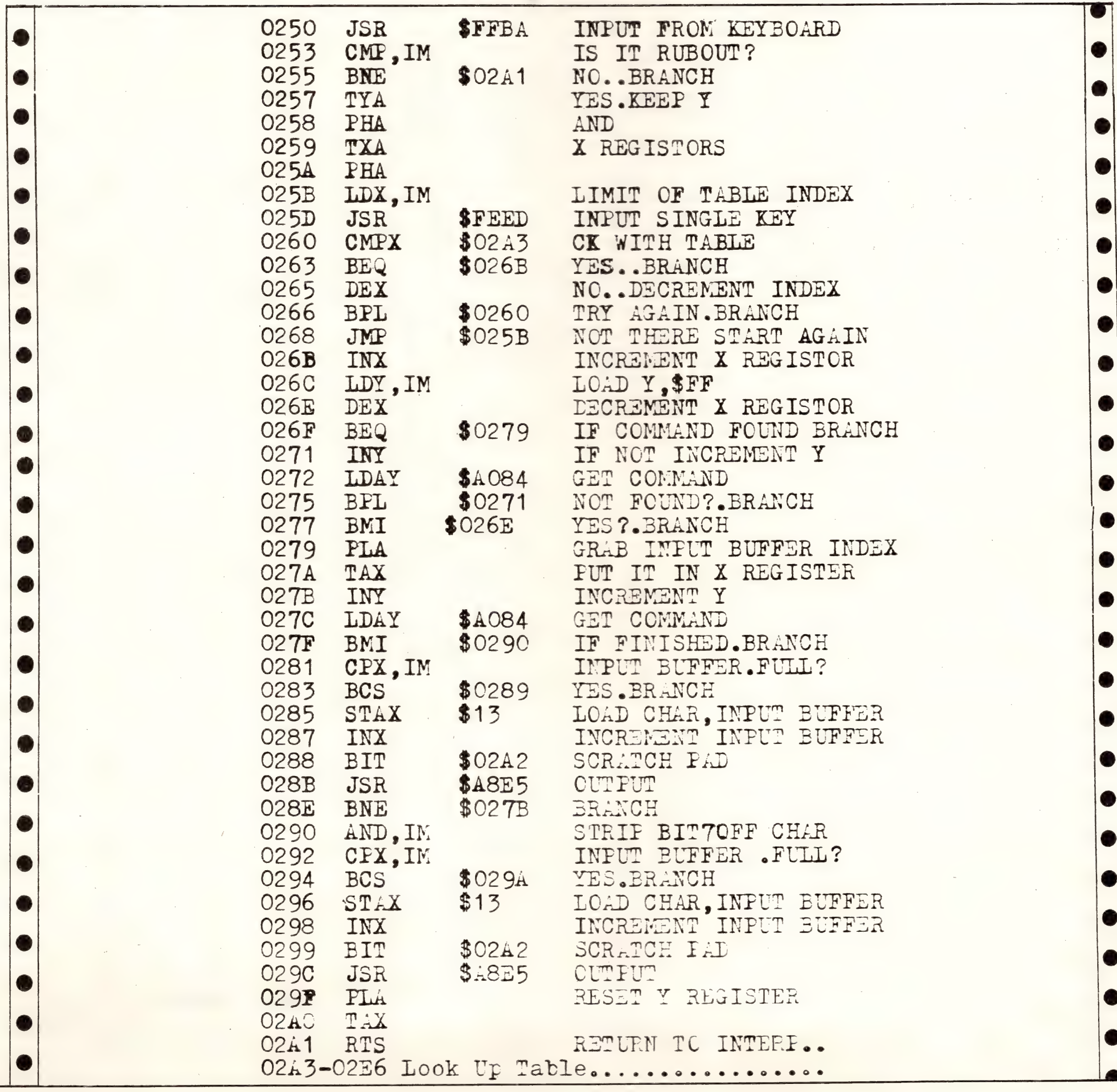
Concluding Peter Brooks' article with the Basic and assembly code listings.

Basic listing



```
1    REM BASIC PROGRAM TO LOAD MACHINE CODE
10   POKE536,80:POKE537,2
20   FOR X = 592 TO 742
30   READY:POKEX,Y:NEXTX:END
40   DATA 32,186,255,201,127,208,74,152,72,138
50   DATA 72,162,67,32,237,254,221,163,2,240,6
60   DATA 202,16,248,76,91,2,232,160,255,202
70   DATA 240,8,200,185,132,160,16,250,48,245
80   DATA 104,170,200,185,132,160,48,15,224,71
90   DATA 176,4,149,19,232,44,162,2,32,229,168
100  DATA 208,235,41,127,224,71,176,4,149,19
110  DATA 232,44,162,2,32,229,168,104,168
120  DATA 96,0
125  REM **look UP TABLE** FROM 130 TO 180
130  DATA 69,70,78,68,73,0,74,0,71,13,0,66,83
140  DATA 82,0,0,0,0,87,0,0,0,79,63,0,76,75
150  DATA 27,0,0,0,0,84,0,81,43,45,42,47,94,0
160  DATA 0,62,61,60,0,57,56,85,72,0,55,48,53
170  DATA 54,50,49,51,52,80,0,88,86,65,67,90
180  DATA 89.77
```

Assembly code listing



```
0250   JSR      $FFBA   INPUT FROM KEYBOARD
0253   CMP,IM           IS IT RUBOUT?
0255   BNE      $02A1   NO..BRANCH
0257   TYA              YES.KEEP Y
0258   PHA              AND
0259   TXA              X REGISTORS
025A   PHA
025B   LDX,IM           LIMIT OF TABLE INDEX
025D   JSR      $FEED   INPUT SINGLE KEY
0260   CMPX     $02A3   CK WITH TABLE
0263   BEQ      $026B   YES..BRANCH
0265   DEX              NO..DECREMENT INDEX
0266   BPL      $0260   TRY AGAIN.BRANCH
0268   JMP      $025B   NOT THERE START AGAIN
026B   INX              INCREMENT X REGISTOR
026C   LDY,IM           LOAD Y,$FF
026E   DEX              DECREMENT X REGISTOR
026F   BEQ      $0279   IF COMMAND FOUND BRANCH
0271   INY              IF NOT INCREMENT Y
0272   LDAY     $A084   GET COMMAND
0275   BPL      $0271   NOT FOUND?.BRANCH
0277   BMI     $026E    YES?.BRANCH
0279   PLA              GRAB INPUT BUFFER INDEX
027A   TAX              PUT IT IN X REGISTER
027B   INY              INCREMENT Y
027C   LDAY     $A084   GET COMMAND
027F   BMI      $0290   IF FINISHED.BRANCH
0281   CPX,IM           INPUT BUFFER.FULL?
0283   BCS      $0289   YES.BRANCH
0285   STAX     $13     LOAD CHAR,INPUT BUFFER
0287   INX              INCREMENT INPUT BUFFER
0288   BIT      $02A2   SCRATCH PAD
028B   JSR      $A8E5   OUTPUT
028E   BNE      $027B   BRANCH
0290   AND,IM           STRIP BIT7OFF CHAR
0292   CPX,IM           INPUT BUFFER .FULL?
0294   BCS      $029A   YES.BRANCH
0296   STAX     $13     LOAD CHAR,INPUT BUFFER
0298   INX              INCREMENT INPUT BUFFER
0299   BIT      $02A2   SCRATCH PAD
029C   JSR      $A8E5   OUTPUT
029F   PLA              RESET Y REGISTER
02A0   TAX
02A1   RTS              RETURN TO INTERP..
02A3-02E6 Look Up Table................
```

APPLE·CATIONS

by Ian Webster, Co-editor of the NSW Apple Users' Group Magazines (Applications) and co-ordinator of the Computerworks Project.

There has been some turmoil within the NSWAUG at recent meetings surrounding the issue of software piracy. This issue has been a constant source of argument within the Apple user community since the bit copy programs of Lee Meador and Omega software appeared at the beginning of the year. Commercial interests claim that the very existence of commercial Apple software is at stake while users argue that they are tired of poor cost/performance software and the uncertainty of operating in the real world without backup.

Locksmith, the program that really started the argument, is a well designed legitimate program that provides Apple users with a 'bit by bit' backup of their software. Although most of the Apple micro-press has argued against the program and refused to accept Locksmith advertising, Omega Software has begun cooperating with software companies and decoding the individual Locksmith serial numbers that are encoded onto all copied disks.

The IAC asked all member groups to consider a motion supporting the recognition of software copyright. When the motion was put to NSWAUG by Roger Keating, the group refused to consider the motion. Roger Keating resigned from the group and will continue to be involved with the NSWAUG only in his capacity as IAC director. The group has elected a committee to consider the issue and report to the next meeting.

Software piracy is having an effect on the availability and cost of software. Software protection costs are now a significant part of any new product release and some programmers have decided not to release or proceed with the development of software that could not be protected. The absence of Apple educational software in Australia can be partly attributed to the disregard for copyright by many teachers and students, although a directive released by the NSW Education Department based on the new Federal Copyright Act should stop most of the copyright violation and encourage programmers to produce educational software.

Most software companies that market applications software now provide backup copies at a nominal cost through dealers or on return of a registration card. If your dealer will not provide backup support for a software product, buy the program from a dealer who will support the product.

The IAC has released the PASCAL 1.1 BIOS ATTACH code. The code enables users to patch non-standard peripheral devices into the PASCAL BIOS. The package includes a small booklet with a commented listing of the BIOS and extensive notes to assist the user with ATTACH. The disk also includes the FORTFIX program to fix some of the bugs in Apple FORTRAN. The disk is available from your local AUG or IAC Director Roger Keating.

Telecom has finally approved the Apple for direct connection to the telephone system. The Apple and the Communications card have been approved and issued Permit no. C81-R7/660. Permit numbers and the TS-76 form will be available from Electronic Concepts. Installation takes about 4 weeks and the cost of a Datel auto-answer modem is about $550. Now that auto-answer modems are available, I hope Apple Bulletin Boards will start to appear around Australia.

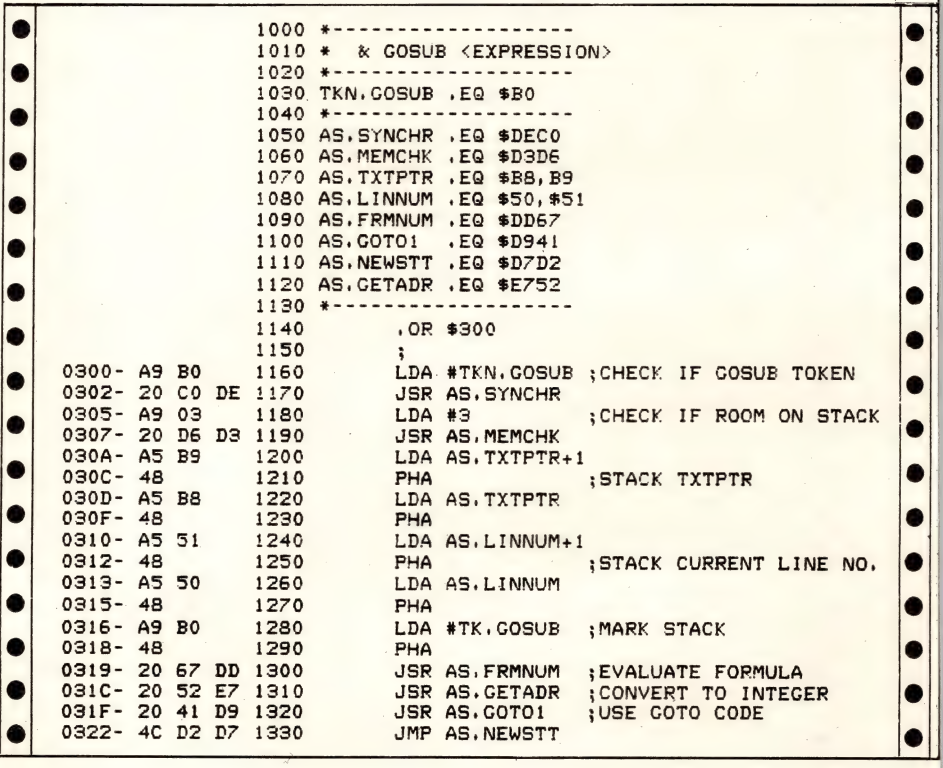
Personal Software has finally released a DOS3.3 version of Visicalc. The new Visicalc has some nice features including the ability to print out formulas separately from data and to boot from Visicalc into another program. If you have a copy of Visicalc and have returned your registration card you will be offered Visicalc 3.3 for US$65.00 (always return registration cards) – the retail price for Visicalc will be over $200.00. Personal Software has also released a series of compatible 'Visi' products – Visitrend, Visiplot, Visidex and Visiterm. Visiplot is a business plotting package, Visitrend analyses stastical data, Visidex is a free-form card index system similar to PFS and Visiterm is a communications package. The programs can share data files using the 'DIF' data format. Together with Desktop Plan II, Personal Software has released an integrated range of personal business software that is unique in the micro world. The company's backup policy and marketing arrogance have been criticised but no one can question Personal Software's vision and capacity to deliver innovative products.

If you have become tired of the latest Hi-res wonder from Nasir or Bill Budge (although wait till you've seen Budge's Raster Blaster) take a look at Bert Kersey's Beagle Bros software. The text screen has been ignored as a field of creative activity in recent years, but Bert Kersey has changed that. His control and skill on the text screen, achieved by precise text placement, use of the SPEED command and a profound understanding of text windows should be experienced by any Apple programmers interested in the design of interactive programs. This routine is an example of his understanding of text windows:

```
FOR 1 = 38 TO O STEP -1
   POKE 31.1 : POKE 32.40-1 :
   HOME
NEXT
```

The product presentation is also innovative, including the Beagle Bros Tip Book (a collection of hacks, patches and Apple oddities) and an Applesoft command chart. The DOS BOSS package is the best as it includes demo versions of several Beagle Bros games as well as the DOS utility program. Many Apple programmers will have written similar programs to Bert Kersey's but few have the skill and elegance of his programs, LOOK and LEARN.

Every time an Apple with a language card is booted the card is reloaded with



```
                  1000 *-------------------
                  1010 *   & GOSUB <EXPRESSION>
                  1020 *-------------------
                  1030 TKN.GOSUB .EQ $B0
                  1040 *-------------------
                  1050 AS.SYNCHR .EQ $DEC0
                  1060 AS.MEMCHK .EQ $D3D6
                  1070 AS.TXTPTR .EQ $B8,B9
                  1080 AS.LINNUM .EQ $50,$51
                  1090 AS.FRMNUM .EQ $DD67
                  1100 AS.GOTO1  .EQ $D941
                  1110 AS.NEWSTT .EQ $D7D2
                  1120 AS.GETADR .EQ $E752
                  1130 *-------------------
                  1140        .OR $300
                  1150        ;
0300- A9 B0       1160        LDA #TKN.GOSUB ;CHECK IF GOSUB TOKEN
0302- 20 C0 DE    1170        JSR AS.SYNCHR
0305- A9 03       1180        LDA #3         ;CHECK IF ROOM ON STACK
0307- 20 D6 D3    1190        JSR AS.MEMCHK
030A- A5 B9       1200        LDA AS.TXTPTR+1
030C- 48          1210        PHA            ;STACK TXTPTR
030D- A5 B8       1220        LDA AS.TXTPTR
030F- 48          1230        PHA
0310- A5 51       1240        LDA AS.LINNUM+1
0312- 48          1250        PHA            ;STACK CURRENT LINE NO.
0313- A5 50       1260        LDA AS.LINNUM
0315- 48          1270        PHA
0316- A9 B0       1280        LDA #TK.GOSUB  ;MARK STACK
0318- 48          1290        PHA
0319- 20 67 DD    1300        JSR AS.FRMNUM  ;EVALUATE FORMULA
031C- 20 52 E7    1310        JSR AS.GETADR  ;CONVERT TO INTEGER
031F- 20 41 D9    1320        JSR AS.GOTO1   ;USE GOTO CODE
0322- 4C D2 D7    1330        JMP AS.NEWSTT
```

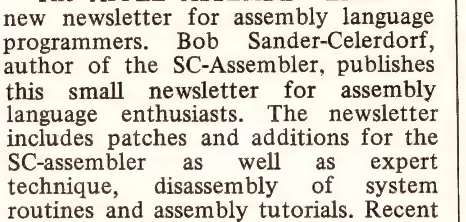
Basic. This irritation can be fixed with a DOS modification to inhibit the reboot by changing the RWTS subroutine that enables the card write switch. The switch can be disabled if the LDA $C081 instruction is changed to LDA $C010. Change Track O, Sector 9, Byte $CC from $81 to $10 on a DOS3.3 disk, using a track/sector utility program. Other disks can be updated from this one using Master Create.

Osbourne/Mcgraw Hill have released the APPLE II USERS GUIDE. The book is a substantial rewrite of the Apple reference manuals illustrated with photographs, diagrams and charts. Chapters cover all aspects of Apple hardware and software operation. The book is the complete reference and overview of the Apple II for new users and should reward experienced users with a few fresh insights. The book should become part of most Apple reference libraries and will be considered essential for multi-user Apple instal-lations.

Apple has just released their version of the Apple Monitor Peeled. This book of detailed information about Monitor routines has been unavailable for some years and has been republished in the Apple reference manual format. The book details all the routines in the old and new Monitor routines with extensive notes concerning Zero page use and register conditioning necessary to use the routines. An essential reference for serious programmers.

The APPLE ASSEMBLY LINE is a new newsletter for assembly language programmers. Bob Sander-Celerdorf, author of the SC-Assembler, publishes this small newsletter for assembly language enthusiasts. The newsletter includes patches and additions for the SC-assembler as well as expert technique, disassembly of system routines and assembly tutorials. Recent issues have included commented disassemblies of DOS3.2.1 RWTS and DOS3.3 disk format routines, notification of a fault in the jump indirect instruction in 6500 microprocessors (JMP ($XXFF) does not execute properly) and several '&' functions including the following routine to implement a computed GOSUB function. The code is in SC-assembler format and the '&' hooks have to be set before the function can be used. The <expression> can be any valid Applesoft expression.

APPLE ASSEMBLY LINE – Box 5537 RICHARDSON TEXAS 75080 US$24.00 (Airmail), (Send a bank draft on a US bank).



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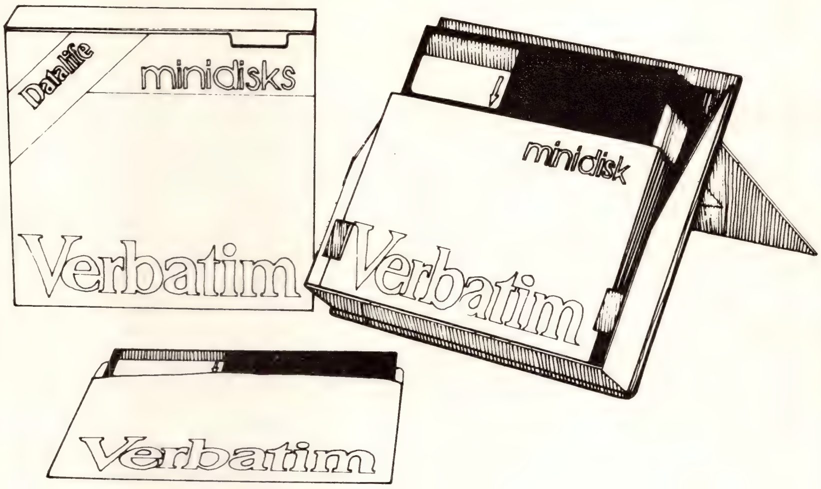

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OSI Basic in ROM

by E. D. Morris, Jr.

While the various Microsoft Basics are easy to use, they are difficult to understand due to an intentional lack of documentation. To help understand your OSI Basic, a table of the locations of the subroutines to service the main commands is presented. The program which generated the table is provided as a starting point for you to explore your Basic.

In this article I wish to delve into the inner workings of Basic by explaining the dispatch table.

At the bottom of the Basic ROMs, between $A000 and $A083, is a list of addresses known as the dispatch table. These are the starting addresses of all the machine subroutines needed to carry out the Basic keywords such as END, FOR, NEXT etc. The addresses are in hexidecimal in the normal machine format of low byte first followed by the high order byte. For example, starting at $A000 you find the data:

```
$A000  39
$A001  A6
$A002  55
$A003  A5
```

Thus the first two entries in the dispatch table are $A639 and $A555. These point to subroutines in the Basic ROMs.

Now we need to know what each subroutine does. Conveniently there is another table starting at $A084 containing a list of all the Basic keywords. The first entries in this table are:

```
$A084  45
$A085  4E
$A086  C4
$A087  46
$A088  4F
$A089  D2
```

Except for the C4 and D2, the data looks like the ASCII code. If the high order bit is removed from C4 and D2, then it is ASCII code for ENDFOR. You can demonstrate the list of keywords for yourself by running the program:

```
10  FOR X=41092 TO 41315
20  Y=PEEK(X)
30  PRINT CHR$ (Y);
40  NEXT
```

If you have the OSI graphics character generator, the last letter of each word will be a graphics character instead of a letter. The high bit being set is used to separate the entries in the word list. To convert these to letters and leave a space between key words, add the following line to the above program:

```
25 IF  Y > 127 THEN PRINT
CHR$(Y−128);:Y=32
```

Now we have two lists, one of addresses and one of functions. These can be combined to give an address for each function.

```
END   $A639
FOR   $A555
```

However things are not quite that simple. Unfortunately the two tables are not strictly in the same order. Also some of the address entries refer to the subroutine location and others to the location, less one. The address table is further complicated in the case of the arithmetic operators by a third entry which is the precedence value.

Following is a Basic program that sorts out these quirks and outputs a list of Basic keywords together with the hex address of the machine code associated with that keyword. Notice that the program does not contain data statements, rather PEEK's directly at your Basic ROM. The program steps through the dispatch table printing out each address. The value of Q is added to each address and is either 1 or 0. The correct keyword is found by PEEKing at D until a character is found with the high bit set.

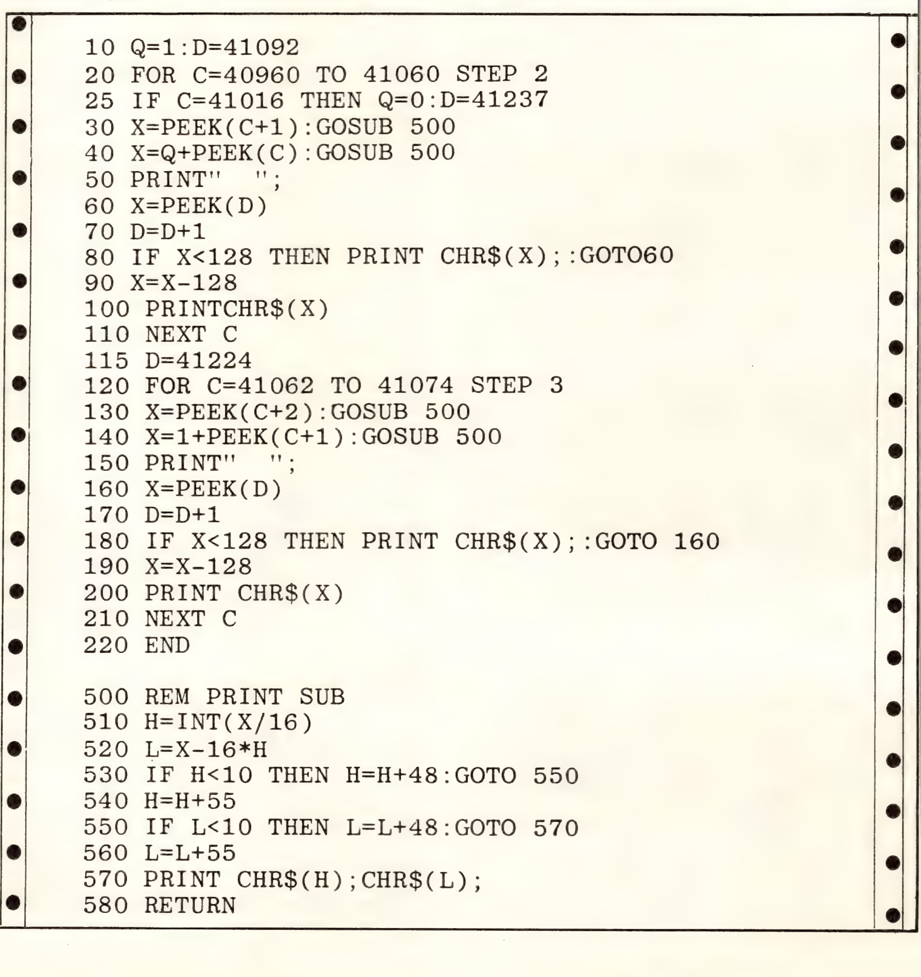
The subroutine at line 500 converts a binary word into ASCII digits for printing.

For those of you who have trouble with this program or for those who have a sore index finger from typing in that 24k game program, I am providing an output listing. However I urge you to run it yourself to prove all this stuff is really "in there." The Basic program also contains information about the location and structure of the two tables.

Looking at the sample run, the addresses for END and FOR found earlier, are incorrect by one byte. Users of the USR function know that the subroutine address must be placed at $000B and $000C. The dispatch table associates location $000A with the USR function. Location $000A contains 4C or JMP which completes the three byte instruction.

It is interesting to note that the Basic keyword table is identical to a numerical listing of the Basic tokens. The keywords TAB, TO, THEN, and STEP are missing from the dispatch table. However these commands are never used alone but always occur with another Basic keyword (PRINT, FOR, IF, and FOR-NEXT). The purists will note the absence of AND, OR, GREATER, LESS and EQUALS. I

Basic Program



```
10 Q=1:D=41092
20 FOR C=40960 TO 41060 STEP 2
25 IF C=41016 THEN Q=0:D=41237
30 X=PEEK(C+1):GOSUB 500
40 X=Q+PEEK(C):GOSUB 500
50 PRINT"  ";
60 X=PEEK(D)
70 D=D+1
80 IF X<128 THEN PRINT CHR$(X);:GOTO60
90 X=X-128
100 PRINTCHR$(X)
110 NEXT C
115 D=41224
120 FOR C=41062 TO 41074 STEP 3
130 X=PEEK(C+2):GOSUB 500
140 X=1+PEEK(C+1):GOSUB 500
150 PRINT"  ";
160 X=PEEK(D)
170 D=D+1
180 IF X<128 THEN PRINT CHR$(X);:GOTO 160
190 X=X-128
200 PRINT CHR$(X)
210 NEXT C
220 END

500 REM PRINT SUB
510 H=INT(X/16)
520 L=X-16*H
530 IF H<10 THEN H=H+48:GOTO 550
540 H=H+55
550 IF L<10 THEN L=L+48:GOTO 570
560 L=L+55
570 PRINT CHR$(H);CHR$(L);
580 RETURN
```

confess, these did not fit neatly into my Basic program.

If you have ever tried to make sense of "that 8k block of data up there at $A000," it looked like a hopeless task. With the dispatch table at hand, you can break it down and attack one function at a time. These subroutines are available to use if you are into machine code programming.

Sample Run
(Program output listing)

```
A63A          END
A556          FOR
AA40         NEXT
A70C         DATA
A923        INPUT
AD01          DIM
A94F         READ
A7B9          LET
A6B9         GOTO
A691          RUN
A73C           IF
A61A      RESTORE
A69C        GOSUB
A6E6       RETURN
A74F          REM
A638         STOP
A75F           ON
A67B         NULL
B432         WAIT
FFF4         LOAD
FFF7         SAVE
AFDE          DEF
B429         POKE
A82F        PRINT
A661         CONT
A4B5         LIST
A68C        CLEAR
A461          NEW
B7D8          SGN
B862          INT
B7F5          ABS
000A          USR
AFAD          FRE
AFCE          POS
BAAC          SQR
BBC0          RND
B5BD          LOG
BB1B          EXP
BBFC          COS
BC03          SIN
BC4C          TAN
BC99          ATN
B41E         PEEK
B38C          LEN
B08C         STR$
B3BD          VAL
B39B          ASC
B2FC         CHR$
B310        LEFT$
B33C       RIGHT$
B347         MID$
B46F            +
B458            -
B5FE            *
B6CD            /
BAB6            ↑
```

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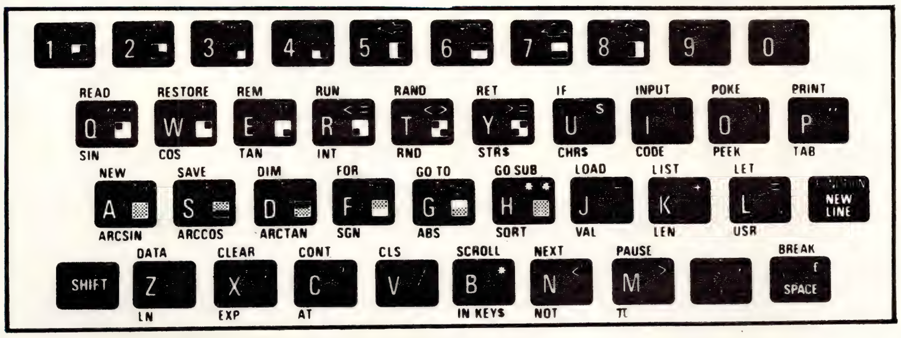

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GEELONG COMPUTER CLUB

Interested people should write to the Geelong Computer Club, P.O. Box 6, Geelong, 3220.

O.S.I./6502 USERS GROUP

For information concerning this newly formed group, please contact Ian Eyles, 10 Forbes St., Essendon, 3040. Phone 345 3478 A.H.

PENINSULA GROUP

This group meets at State College, Frankston, on the second Thursday of each month except during January. Those interested may contact M.G. Thompson on 772 2674.

AUSOM

Apple Users' Society of Melbourne. Contact Mr David Turk of Computerland Melbourne.

S.M.U.G.

To find out more about this group of SORD M100 users, contact Mr Robin Miller, 60 Winmalee Drive, Glen Waverley, 3150.

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Write to Mr L. Ferguson of 12 Morphett Avenue, Ascot Vale for all the information necessary.

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Nicki Saunders on 614 1433 during business hours, has all the information.

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AUSTRALASIA ZX80 USERS' GROUP

This recently formed group aims to promote the use and growth of the Sinclair ZX80. A newsletter with listings of original programs submitted by members and friends, handy subroutines and other programming aides, as well as reviews on purchased software–hardware will be produced.
Anyone interested in the ZX80 may contact Tony Mowbray, 87 Murphys Ave., Kieraville, 2500. Phone (042) 28 5296.

COMMODORE USER GROUP

For more details, drop a line to Mr John Guidice, C/- The Commodore Users Group, G.P.O. Box 4721, Sydney, 2001

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If you are interested, Andrew MacIntosh of 91 Regent Street, Chippendale, is the man to see.

80AT

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This group meets at 7.30p.m. on the first Tuesday of each month at the Adelaide University Union Building. Further information is available from Earle Rowan, Commodore Computer Users' Association of S.A., P.O. Box 60, Clarence Gardens, 5039.

A.C.T.

MICSIG

Further information concerning MICSIG, from the Registrar, MICSIG, C/- P.O. Box 446, Canberra City, 2601.

TASMANIA

TASMANIA APPLE USERS' CLUB

Meetings are held on the 3rd Tuesday of each month at various locations. New members are most welcome and enquiries may be made to Ray Williams, President/Secretary, P.O. Box 188, North Hobart, 7002. Tel: (002) 34 1271.

TEMOS

All enquiries are welcome and may be directed to John Stephenson, President, 4 Melinga Place, Taroona, 7000. Ph: 27 8770

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NEWCOMERS-START HERE

What follows is a brief guide for the microcomputing novice. It has been designed for quick reference — with all the key words in bold type; of course if you're feeling adventurous, you're welcome to read it right through. Whichever way, we trust you will find it helpful. Happy Microcomputing!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say "numbering system with a radix of sixteen in which the letters A to F represent the values 10 to 15", when instead we can simply say "hex". No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, APC will be publishing this guide – every month.

We'll start by considering a microcomputer's functions and then examine the physical components necessary to implement these functions.

The microcomputer is capable of receiving information, processing it, storing the results or sending them somewhere else. All this information is called **data** and it comprises numbers, letters and special symbols which can be read by humans. Although the data are (yes, it's plural) accepted and output by the computer in 'human' form, inside it's a different story – they must be held in the form of an electronic code. This code is called **binary** – a system of numbering which uses only Os and 1s. Thus in most micros each character, number or symbol is represented by eight binary digits or **bits** as they are called, ranging from 00000000 to 11111111.

To simplify communication between computers, several standard coding systems exist, the most common being **ASCII** (American Standard Code for Information Interchange). As an example of this standard, the number five is represented as 00110101 – complicated for humans, but easy for the computer! This collection of eight bits is called a byte and computer freaks who spend a lot of time messing around with bits and bytes use a half way human representation called **hex**. The hex equivalent of a byte is obtained by giving each half a single character code (0–9, A–F):
0=0000, 1=0001, 2=0010, 3=0011, 4=0100, 5=0101 ...... E=1110 and F=1111.
Our example of 5 is therefore 35 in hex. This makes it easier for humans to handle complicated collections of Os and 1s. The machine detects these Os and 1s by recognising different voltage levels.

The computer processes data by reshuffling, performing arithmetic on, or by comparing them with other data. It's the latter function that gives a computer its apparent 'intelligence' – the ability to make decisions and to act upon them. It has to be given a set of rules in order to do this and, once again, these rules are stored in memory as bytes. The rules are called **programs** and while they can be input in binary or hex (**machine code** programming), the usual method is to have a special program which translates English or near-English into machine code. This speeds programming considerably; the nearer the **programming language** is to English, the faster the programming time. On the other hand, program execution speed tends to be slower.

The most common microcomputer language is **BASIC.** Program instructions are typed in at the keyboard, to be coded and stored in the computer's memory. To run such a program the computer uses an **interpreter** which picks up each English-type **instruction,** translates it into machine code and then feeds it into the **processor** for execution. It has to do this each time the same instruction has to be executed.

Two strange words you will hear in connection with BASIC are **PEEK** and **POKE.** They give the programmer access to the memory of the machine. It is possible to read (PEEK) the contents of a byte in the computer and to modify a byte (POKE).

Moving on to hardware, this means the physical components of a computer system as opposed to software – the programs needed to make the system work.

At the heart of the microcomputer system is the central processing unit **(CPU)**, a single microprocessor chip with supporting devices such as **buffers**, which 'amplify' they CPU's signals for use by other components in the system. The packaged chips are either soldered directly to a printed circuit board **(PCB)** or are mounted in sockets.

In some microcomputers, the entire system is mounted on a single, large, PCB; in others a bus system is used, comprising a long PCB holding a number of interconnected sockets. Plugged into these are several smaller PCBs, each with a specific function – for instance, one card would hold the CPU and its support chips. The most widely-used bus system is called the **S100**.

The CPU needs **memory** in which to keep the programs and data. Microcomputers generally two types of memory, **RAM** (Random Access Memory) and **ROM** (Read Only Memory). The CPU can read information stored in RAM – and also put information into RAM. Two types of RAM exist – **static** and **dynamic**; all you really need to know is that dynamic RAM uses less power and is less expensive than static, but it requires, additional, complex, circuitry to make it work. Both types of RAM lose their contents when power is switched off, whereas ROM retains its contents permanently. Not surprisingly, manufacturers often store interpreters and the like in ROM. The CPU can only read the ROM's contents and cannot alter them in any way. You can buy special ROMs called **PROMs** (Programmable ROMs) and **EPROMs** (Erasable PROMs) which can programmed using a special device; EPROMs can be erased using ultra-violet light.

Because RAM loses its contents when power is switched off, **cassettes** and **floppy discs** are used to save programs and data for later use. Audio-type tape recorders are often used by converting data to a series of audio tones and recording them; later the computer can listen to these same tones and re-convert them into data. Various methods are used for this, so a cassette recorded by one make of computer won't necessarily work on another make. It takes a long time to record and playback information and it's difficult to locate one specific item among a whole mass of information on a cassette; therefore, to overcome these problems, floppy discs are used on more sophisticated systems.

A floppy disc is made of thin plastic, coated with a magnetic recording surface rather like that used on tape. The disc, in its protective envelope is placed in a disc drive which rotates it and moves a **read/write head** across the disc's surface. The disc is divided into concentric rings called **tracks**, each of which is in turn subdivided into sectors. Using a program called a **disc operating system,** the computer keeps track of exactly where information is on the disc and it can get to any item of data by moving the head to the appropriate track and them waiting for the right sector to come round. Two methods are used to tell the computer where on a track each sector starts; **soft sectoring** where special signals are recorded on the surface and **hard sectoring** where holes are punched through the disc and around the central hole, one per sector.

Half-way between cassettes and discs is the **stringy floppy** – a miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disc system. Hard disc systems are also available for microcomputers; they store more information than floppy discs, are more reliable and information can be transferred to and from them much more quickly.

You, the user, must be able to communicate with the computer and the generally accepted minimum for this is the visual display unit **(VDU)**, which looks like a TV screen with a typewriter-style keyboard; sometimes these are built into the system, sometimes they're separate. If you want a written record **(hard copy)** of the computers output, you'll need a **printer**.

The computer can send out and receive information in two forms – **parallel** and **serial**. Parallel input/output (I/O) requires a series of wires to connect the computer to another device, such as a printer, and it sends out data a byte at a time, a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single piece of wire, with extra bits added to tell the receiving device when a byte is about to start and when it has finished. The speed that data is transmitted is referred to as **baud rate** and, very roughly, the baud rate divided by 10 equals the number of bytes being sent per second.

To ensure that both receiver and transmitter link up without any electrical horrors, standards exist for serial interfaces the most common is **RS232** (or **V24**) while, for parallel interfaces to printers, the **Centronics** standard is popular.

Finally, a **modem** connects a computer, via a serial interface to the telephone system allowing two computers with modems to exchange information. A modem must be wired into the telephone system and you need Telecom's permission; instead you could use an **acoustic coupler**, which has two obscene-looking rubber cups into which the handset fits, and which has no electrical connection with the phone system – Telecom isn't so uppity about the use of these.

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PROGRAMS

PET Replace

by Trevor Lusty

Do you like those multiplication puzzles in which each digit is replaced by a letter of the alphabet? If you do you'll love this program — it generates such puzzles till the cows come home.

```
1000 REM"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒
1020 REM"▒                         ▒
1040 REM"▒ "REPLACE"               ▒
1060 REM"▒                         ▒
1080 REM"▒ TREVOR LUSTY   25/6/1980 ▒
1100 REM"▒
1120 REM"▒    A MULTIPLICATION GAME ▒
1140 REM"▒ WHERE ALL THE DIGITS ARE ▒
1160 REM"▒ REPLACED BY LETTERS.     ▒
1180 REM"▒                         ▒
1200 REM"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒
1220 GOSUB 2540:GOSUB 2700
1240 U=0 T1=0:POKE 59468,12
1260 PRINT "▯  HOLD IT! --- PROBLEM SETTING."
1280 FOR I=0 TO 10:E$(I)="":K$(I)="":Q$(I)="":K(I)=-1:K1(I)=-1:NEXT I
1300 GZ=0:W=0:F$=" ":C$="ABCDEFGHIJ":FQ$=" 1234567890"
1320 R=INT(LEN(C$)*RND(1)+1):N$=MID$(C$,R,1):F$=F$+N$:T$=""
1340 IF R>1 THEN T$=LEFT$(C$,R-1):GOTO 1360
1360 C$=T$+MID$(C$,R+1):IF LEN(C$)>0 THEN 1320
1380 REM *** WORK OUT THE SUM ***
1400 N(0)=100+INT(900*RND(1))
1420 IF N(0)/10=INT(N(0)/10) THEN 1400
1440 N(1)=10+INT(90*RND(1))
1460 IF N(1)/10=INT(N(1)/10) THEN 1440
1480 N(2)=N(0)*(N(1)-10*INT(N(1)/10))
1500 N(3)=N(0)*INT(N(1)/10)
1520 N(4)=N(0)*N(1)
1540 REM *** REPLACE WITH LETTERS ***
1560 FOR X=0 TO 4:B=0:EQ$(X)="":E$(X)="":FOR Y=1 TO 5
1580 A=INT(N(X)/INT(10↑(5-Y)+.5)):C=A-10*B:B=A
1600 E$(X)=E$(X)+MID$(F$,C+1,1)
1620 EQ$(X)=EQ$(X)+MID$(FQ$,C+1,1)
1640 NEXT Y:NEXT X:E$(3)=RIGHT$(E$(3),4)+" "
1660 EQ$(3)=RIGHT$(EQ$(3),4)+" "
1680 REM *** SORT OUT THE ZERO'S ***
1700 FOR X=0 TO 4:FL=0
1720 FOR Y=1 TO LEN(E$(X))
1740 IF MID$(E$(X),Y,1)<>" " THEN FL=1
1760 IF FL=0 OR MID$(E$(X),Y,1)<>" " THEN 1820
1780 E$(X)=LEFT$(E$(X),Y-1)+RIGHT$(F$,1)+RIGHT$(E$(X),5-Y)
1800 EQ$(X)=LEFT$(EQ$(X),Y-1)+RIGHT$(FQ$,1)+RIGHT$(EQ$(X),5-Y)
1820 NEXT Y:NEXT X
1840 REM *** PRINT THE PROBLEM AND ***
1860 REM *** INPUT THE NEXT GUESS. ***
1880 GOSUB 3880
1900 GOSUB 3300:IF F THEN PRINT:PRINT "▯▮QUIT■            ":GOSUB 4000:END
1920 GZ=GZ+1:IF GZ>31 THEN GZ=0
1940 Z=ASC(Z$)-64:IF N<>K1(Z) THEN 1980
1960 M$="YOU ALREADY KNOW THAT":GOSUB 3760:GOTO 1900
1980 IF N<>K(N) THEN 2020
2000 M$=MID$(F$,N+1,1)+" = "+RIGHT$(STR$(N),1)+",  ▮TWERP■":GOSUB 3760:GOTO 1900
2020 IF Z$<>K$(Z) THEN 2060
2040 M$=Z$+" = "+RIGHT$(STR$(K1(Z)),1)+",  ▮TWERP■":GOSUB 3760:GOTO 1900
2060 IF Z$=Q$(N) THEN M$="YOU GUESSED THAT BEFORE":GOSUB 3760:GOTO 1900
2080 IF Z$=MID$(F$,N+1,1) THEN 2180
2100 W=W+1:M$="QQQ WRONG QQQ  THAT'S"+STR$(W)+" MISSES":GOSUB 3760:GOSUB 3880
2120 Q$(N)=Z$:GOTO 1900
2140 REM *** INSERT DIGIT AND ***
2160 REM *** CHECK FOR END.   ***
2180 N1=50:FOR X=0 TO 4:FOR Y=1 TO 5
2200 T$=MID$(E$(X),Y,1):M=ASC(T$):M1=M-64
2220 IF T$=" " THEN 2320
2240 IF T$<>Z$ THEN 2300
2260 E$(X)=LEFT$(E$(X),Y-1)+RIGHT$(STR$(N),1)+RIGHT$(E$(X),5-Y)
2280 K(N)=N:K$(M1)=Z$:K1(M1)=N:M=0
2300 IF M>N1 THEN N1=M
2320 NEXT Y:NEXT X
2340 IF N1<61 THEN 2380
2360 PRINT:GOTO 1880
2380 GOSUB 3880:PRINT "▮WELL DONE --- YOU GOT IT"
2400 PRINT "▮    MISSES =";W
2420 T1=T1+W:U=U+1
2440 PRINT "    AVERAGE=";T1/U
2460 PRINT "▮    ANOTHER GAME ? ";:GOSUB 3120
2480 IF A$="Y" THEN 1260
2500 PRINT:PRINT "▮▮BYE-BYE   HOPE YOU ENJOYED IT■           "
2520 PRINT "▮                                   ":END
2540 REM *** TITLE PAGE ***
2560 POKE 59468,14:PRINT "▯▮▮▮▮▮▮▮▮▮▮"
2580 PRINT TAB(12);"▮         ■"
2600 PRINT TAB(12);"▮ REPLACE ■"
2620 PRINT TAB(12);"▮         ■"
2640 PRINT "▮▮▮";TAB(16);"BY"
2660 PRINT "▮";TAB(11);"TREVOR LUSTY"
2680 RETURN
2700 REM *** INSTRUCTIONS ***
2720 PRINT "▮▮▮▮     ▮DO YOU WANT INSTRUCTIONS■ ? ";
2740 GOSUB 3120:IF A$<>"Y" THEN RETURN
2760 PRINT "▯  REPLACE WILL PRESENT YOU WITH A"
2780 PRINT "MULTIPLICATION PROBLEM WHICH HAS DIGITS"
2800 PRINT "REPLACED BY LETTERS."
2820 PRINT "▮  FOR EXAMPLE :-▮"
2840 PRINT "       D F B           4 6 2"
2860 PRINT "      X  G I         X  7 9"
2880 PRINT "      ──────         ───────"
2900 PRINT "     D A E H         4 1 5 8"
```

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WITH SOUND

Your screen is transformed into a maze-like playfield. As your ship appears, eight alien ramships also appear; all of them are travelling at flank speed directly at you! Quickly you move towards them and fire missiles to destroy them. But, the more aliens you destroy, the faster the remaining ones become.

If you get too good you must endure the wrath of the keeper of the mazefield the menacing 'Flagship'. You must destroy him fast because that guy's accurate!

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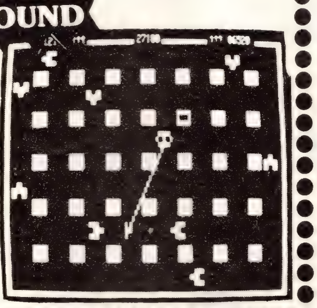
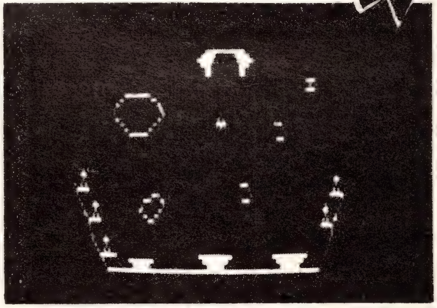


METEOR MISSION 11

NEW



The second **BIG BANG** has occurred and the galaxy is full of stray asteroids and meteors. As you look through your space port you see a belt of asteroids drifting across the screen blocking your path to the safety of the space station above. Be careful because meteor showers and exploding suns and invading aliens may strike your ship and send it hurtling back to ground level. How many times can you and your opponent manoeuvre through these obstacles before time runs out? With sound effects!

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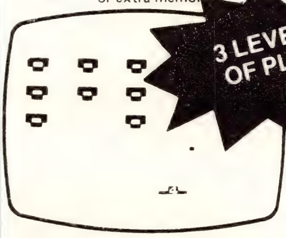

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PROGRAMS

TRS-80 Demon Hunts

by Easy Computing

Catch the demons and replace them with a gravestone — great fun.

```
70 '                    ** VARIABLE INITIALIZATION **
80 CLS:CLEAR175:DEFINTA-Z:H=9999
90 A$=STRING$(57,153):B$=STRING$(63,153):E$=STRING$(3,153)
100 C$=STRING$(3,32):V$=CHR$(182)+CHR$(140)+CHR$(185)
110 Y$=CHR$(191)+CHR$(179)+CHR$(191):U$="####":US$="##":P=15360
120 D$=CHR$(140)+CHR$(191)+CHR$(140):GOSUB340
130 PRINT@3,A$;:PRINT@960,B$;:FORE=64TO896STEP64:PRINT@E,E$;
140 PRINT@E+60,E$;:NEXT
150 V=481:U=V:Y=451:X=Y:R=RND(3)+1
160 '                          ** ACTUAL GAME **
170 FORS=0TO30000:PRINT@Y,C$;:D=PEEK(14400)
180 IFD=64Y=Y+3ELSEIFD=32Y=Y-3ELSEIFD=16Y=Y+64ELSEIFD=8Y=Y-64
190 N=PEEK(P+Y):IFN=32X=YELSEIFN<182Y=XELSE260
200 PRINT@Y,Y$;:IFPEEK(P+V)=182PRINT@V,C$;
210 PRINT@60,USINGU$;TS+S;:M=M+1:IFM=3R=RND(4):M=0
220 IFR=1V=V-3ELSEIFR=2V=V-64ELSEIFR=3V=V+3ELSEIFR=4V=V+64
230 B=PEEK(P+V):IFB=32U=VELSEIFB=153V=U:M=0:R=R+1:IFR>4R=1
240 IFB<>191IFB=140NEXTSELSEPRINT@V,V$;:NEXTS
250 '                        ** SCORE ROUTINE **
260 TS=TS+S:PRINT@Y,D$;:K=K+1:PRINT@0,USINGUS$;K;
270 FORT=0TO1000:NEXT:IFK<20THEN150
280 CLS:IFTS>HTHENPRINTTAB(28)HN$;"  :";H:GOTO310
290 H=TS:PRINTTAB(13)"WELL DONE YOU ONLY NEEDED";H;"TIME-UNITS"
300 PRINT:PRINTTAB(18)"PLEASE ENTER YOUR NAME";:INPUTHN$
310 PRINT:PRINTTAB(19)"DO YOU WANT TO PLAY AGAIN";:INPUTP$
320 IFLEFT$(P$,1)="N"THENENDELSETS=0:K=0:CLS:GOTO130
330 '                        ** INSTRUCTIONS **
340 PRINTTAB(17)"DEMON HUNT BY EASY COMPUTING"
350 PRINTTAB(17)STRING$(28,34)
360 PRINTTAB(22)"-= INSTRUCTIONS =-":PRINT
370 PRINT"THE OBJECT OF THE GAME IS TO KILL A MOVING DEMON ";
380 PRINTV$;" USING THE  ARROW KEYS. A DEAD DEMON WILL BE ";
390 PRINT"DISPLAYED IN THE FORM OF A      CROSS ";D$;". ";
400 PRINT"THE CROSS WILL BE AN OBSTACLE FOR YOU ";Y$;
410 PRINT" BUT NOT FORTHE NEXT DEMONS. AS SOON AS YOU KILLED ";
420 PRINT"20 DEMONS THE GAME IS     OVER."
430 PRINT:PRINTTAB(19):INPUT"PRESS ENTER TO CONTINUE";C:CLS
440 RETURN
```

BLUDNERS

Well, er, yes, the 'TRS-80 Giant Trap' program in last month's issue was actually for the PET. March's 'TRS-80 Rocket Attack' had a couple of hard to read lines. Line 3170 should be GOTO 9000 and 9020 ends with POKE EE,E.

And, of course, the biggest blunder of all – the inclusion of a layout instruction in May's Newsprint – was really designed to give you an insight into magazine production.

PET Chords

Are you a would-be guitarist? If you are then you'll find this program a great way to learn your chord fingering.

```
     10 REM CHORDS-JEFF AUGHTON
     20 REM
     30 GOSUB800:Z$="                    "
     40 DIMN%(30),S(6),C$(12,9),T$(9),R$(12),A%(100)
     50 FORI=1TO6:READS(I):NEXT
     60 FORI=1TO9:READT$(I):NEXT
     70 FORI=1TO12:READR$(I):NEXT
     80 FORI=1TO30:READN%(I):NEXT
     85 FORI=1TO12 FORJ=1TO9
     90 READC$(I,J):NEXTJ,I
     95 S=59464:Q=3:X=0:D$="▓▓▓▓▓▓▓▓▓▓"
     100 PRINT"PRESS SPACE TO START AND TO CHANGE CHORD
     105 GETA$:IFA$<>" "THEN105
     110 PRINT"▓▓▓":FORI=1TO9
     120 PRINTTAB(26);I;T$(I)
     130 PRINT:NEXT
     140 POKES+3,16:POKES+2,16:POKES,0
     150 X=X+1:GOSUB500
     160 GOSUB600:PRINT"ROOT NOTE";
     170 INPUT"   .███";A$
     180 FORI=1TO12:IFA$=R$(I)THEN260
     190 NEXT:IFA$<>"X"THEN160
     200 PRINT"▓TEMPO - 0=FAST,9=SLOW▓
     210 INPUT"YOUR CHOICE";Q
     220 PRINT"▓":FORM=1TOX-1
     230 N=INT(A%(M)/10):T=A%(M)-10*N
     240 GOSUB500:GOSUB350
     250 NEXT:GOSUB600:GOTO910
     260 N=I
     270 GOSUB600:PRINT"CHORD TYPE";
     280 INPUT"   .███";A$
     290 T=ASC(A$)-48
     300 IFT<1ORT>9THEN270
     310 GOSUB350
     320 GETA$:IFA$<>" "THENGOSUB360:GOTO320
     330 A%(X)=10*N+T:GOTO150
     340 REM SUBROUTINES & DATA
     350 GOSUB600
     360 PRINT"▓▓";R$(N);" ";T$(T)
     370 FORJ=1TO6:FORI=1TO3
     380 Z=ASC(MID$(C$(N,T),I,1))-65
     390 H=INT(Z/5):L=Z-5*H
     400 A$="o":IFHTHENA$="●"
     410 PRINT"▓▓▓▓▓";SPC(4*I+1);LEFT$(D$,2*H+1);A$
     420 Z=N%(S(2*I-1)+H):GOSUB480
     430 A$="o":IFLTHENA$="●"
     440 PRINT"▓▓▓▓▓";SPC(4*I+3);LEFT$(D$,2*L+1);A$
     450 Z=N%(S(2*I)+L):GOSUB480
     460 NEXTI
     470 POKES,0:RETURN
     480 POKES,Z:FORK=0TO12*Q:NEXTK:RETURN
     500 PRINT"▓▓▓▓▓▓";Z$
     505'PRINT"          ━━━━━━━━━━ "
     510 FORI=1TO5
     520 PRINT"          | | | | | |"
     530 PRINT"          ├─┼─┼─┼─┼─┤"
     540 NEXT:RETURN
600 PRINT"▓";Z$;"▓";:RETURN
620 DATA 1,6,11,16,20,25
630 DATA MAJOR,MINOR,MAJ.7,MIN.7,AUGMENTED
640 DATA SIXTH,SEVENTH,DIMINISHED,NINTH
650 DATA C,C#,D,D#,E,F,F#,G,G#,A,A#,B
660 DATA 188,177,167,157,148,140,132,125,117,111,104,98,93
670 DATA 87,82,78,73,69,65,61,58,54,51,48,45,43,40,38,36,34
680 DATA SKF,SFI,SKA,QII,DLF,DMF,DNF,KHH,SNS
690 DATA JQL,ELK,JQG,CLK,FRL,GQL,JTL,BKK,YTY
700 DATA KCR,FCQ,KCM,FCG,LXR,KER,KCH,HBB,KCF
710 DATA QIX,LIW,QIS,LJM,RFD,QII,LIN,KHH,GIL
720 DATA CLA,CKA,CGA,CKP,DLF,CLK,CLP,BKK,CBC
730 DATA IRG,IQG,FRF,IGV,FRL,ICQ,IHG,HBB,IHI
740 DATA OXM,OWM,OSL,OMM,LXR,OXW,ONM,KHH,ONO
750 DATA RAD,BSS,MAC,QAQ,RFD,RKP,RAB,BKK,RCB
760 DATA XGJ,WGY,XGI,MGB,DLF,XGV,XGH,HBB,LGH
770 DATA AMK,AMF,AMO,AKF,FRL,AMM,AKK,KHH,AMD
780 DATA GSQ,GSL,GRQ,GQL,LXR,GSS,GOO,BKK,GBG
790 DATA MYW,MYR,MXW,MWR,RFD,MYY,MHC,HBB,LMM
800 PRINT"▓             GUITAR CHORDS▓
810 PRINT"GIVE ME THE ROOT NOTE,FOLLOWED BY THE▓"
820 PRINT"TYPE OF CHORD (1 TO 9-SEE KEY) AND I'LL▓"
830 PRINT"SHOW YOU HOW TO PLAY IT.USE NO FLATS-▓"
840 PRINT"ONLY SHARPS,FOR EXAMPLE:▓"
850 PRINT"          B FLAT = A SHARP = A#▓
860 PRINT"CONNECT A SOUND BOX,AND YOU CAN HEAR ME▓"
870 PRINT"PLAY!!▓":PRINT"AT THE END OF THE SESSION TYPE X FOR▓"
880 PRINT"THE ROOT NOTE AND I WILL PLAY ALL THE▓"
890 PRINT"CHORDS YOU HAVE GIVEN ME IN SEQUENCE.▓"
900 RETURN
910 PRINT"WANT TO HEAR IT AGAIN? (Y/N)"
920 GETA$:IFA$="Y"THEN200
```

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```
930 IFA$<>"N"THEN920
940 PRINT"ANOTHER SEQUENCE? (Y/N)█"
950 GETA$:IFA$="Y"THEN95
960 IFA$<>"N"THEN950
970 POKES+3,0:END
```

UK101 Machine Language to Basic Converter

by J G Patton

Have you got a machine code routine that you'd like to save and load simply? Use this program to convert the code into Basic DATA statements and to attach a small loader to make it easy to reload. A sample run follows the program listing.

```
 5 REM MACHINE LANGUAGE TO BASIC LOADER TAPE CONVERSION PROGRAM
 7 REM FOR OSI SUPERBOARD II
 10 REM WRITTEN BY EAMONN J.G. PATTON -JAN '81
 20 REM SL=CURRENT LINE NO.
 25 REM SA=START ADDRESS OF MACHINE CODE PROGRAM
 30 REM EA=END ADDRESS OF SAME
35 REM ARRAY A$ CONTAINS BASIC KEY WORDS
40 REM V=FLAG IF VECTOR TO BE SET(-1=TRUE)
45 REM T=LOOP VARIABLE
50 REM A$=GENERAL INPUT STRING VARIABLE
55 REM Q$=TEMP. STRING VARIABLE
60 REMV1-V4&V6 USED AS TEMP VARIABLES IN HEX-DEC CONVERSION
65 REM VH CONTAINS HIGH BYTE OF VECTOR
70 REM VL CONTAINS LOW BYTE OF VECTOR
75 REM VB CONTAINS ADDRESS OF VECTOR LOW BYTE
80 REM LINES 100-160 INPUT DATA ABOUT M/C PROG
81 REM LINES 170-180 SET UP ARRAY WITH KEYWORDS
82 REM LINES 190-360 SAVE ON TAPE
83 REM LINES 5000-5005 INCREMENT LINE NO. AND CHECK NOT TOO HIGH
84 REM LINES 10000-10130 GET VECTOR & SPLIT TO HIGH&LOW BYTE
85 REM LINES20000-20020 ERROR ROUTINE IF LINE NO. TOO HIGH(BIG PROG!
100 INPUT"START ADDRES";SA:REMSTART ADDRES
105 SA=INT(SA)
110 IFSA<0ORSA>2^16THEN100
120 INPUT"END ADDRESS";EA
125 EA=INT(EA)
130 IFEA<0OREA<=SAOREA>2^16THEN100
140 INPUT"IS THERE A VECTOR TO SET";A$
150 IFLEFT$(A$,1)="Y"THENGOSUB10000:V=-1:REMGETVECTORVFLAG=-1IFTRUE
160 INPUT"STARTLINE NO.";SL:IFSL>63000ORSL<0ORSL<>INT(SL)THEN160
161 REM HIGHEST LINE NO. IN BASIC IS 63999
170 DIMA$(7):FORT=0TO7:READA$(T):NEXT
171 REM READ IN 'PROGRAM STATEMENTS'
180 DATA"DATA",",","FORX=","TO","READA","POKEX,A","NEXT","POKE"
190 POKE11,0:POKE12,253 :PRINT"PRESS PLAY AND RECORD AND HIT A";
191 POKE15,255:PRINT" KEY WHEN READY":X=USR(X)
195 REM JUMP TO MONITOR SUBROUTINE WHICH WAITS UNTIL KEY PRESSED
199 PRINT:PRINT:PRINT
200 SAVE:POKE15,72:REM SET THE SAVE MODE AND TERMINAL WIDTH
201 PRINTCHR$(64):PRINT:REM CLEAR NOISE CHARACTERS
205 GOSUB5000:REMNEWLINENO.
210 FORT=SATOEA
220 V1=PEEK(T)
230 PRINTV1;
240 IFPEEK(14)>65ANDT<EATHENPRINT:GOSUB5000:GOTO250
241 REM NEAR END OF LINE
244 IFT>=EATHEN250
245 PRINTA$(1);
250 NEXTT
270 PRINT
280 SL=SL+10:IFSL>63999THEN20000
290 PRINTSL;A$(2);SA;A$(3);EA
295 SL=SL+10:IFSL>63999THEN20000
300 PRINT::PRINTSL;A$(4);":";A$(5)
305 SL=SL+10:IFSL>63999THEN20000
310 PRINT:PRINTSL;A$(6)
320 IFVTHEN340
330 POKE517,0:END
340 SL=SL+10:IFSL>63999THEN20000
350 PRINTSL;A$(7);VB;A$(1);VL;":";A$(7);VB+1;A$(1);VH
360 POKE517,0:END
5000 PRINTSL;A$(0);:SL=SL+10:IFSL>63999THEN20000
5005 RETURN
10000 INPUT"VECTOR-IN HEX";A$
10004 REM ERROR CHECK
10005 IFLEN(A$)<>4THEN10000
10007 FORV6=1TO4:Q$=MID$(A$,V6,1)
10008 IF(Q$>="0"ANDQ$<="9")OR(Q$>="A"ANDQ$<="F")THEN10010
10009 GOTO10000
10010 NEXTV6
10015 IFLEFT$(A$,1)>"9"THENV1=9+ASC(LEFT$(A$,1))-64:GOTO10030
10020 V1=VAL(LEFT$(A$,1))
10030 IFMID$(A$,2,1)>"9"THENV2=9+ASC(MID$(A$,2,1))-64:GOTO10050
10040 V2=VAL(MID$(A$,2,1))
10050 VH=16*V1+V2
10060 IFMID$(A$,3,1)>"9"THENV3=9+ASC(MID$(A$,3,1))-64:GOTO10080
10070 V3=VAL(MID$(A$,3,1))
10080 IFMID$(A$,4,1)>"9"THENV4=9+ASC(MID$(A$,4,1))-64:GOTO10100
10090 V4=VAL(MID$(A$,4,1))
10100 VL=16*V3+V4
10110 INPUT"ADDRESS OF VECTOR LOW BYTE IN DEC.";VB
10120 IFVB<0ORVB>2^16ORVB<>INT(VB)THEN10110
10130 RETURN
```

ZX80 Sliding letters

by B Cope

Here is the computer version of the game where you slide interlocking lettered tiles around on a 4 x 4 board until they are all in alphabetical order.

Enter this program and press RUN. There are three degrees of difficulty — so try the easy one first. A randomly generated board will be displayed with one blank tile.

Type in the letter that you wish to slide into the blank position. Illegal requests will be ignored. A correct board with the blank in the lower right corner will be acknowledged, and another turn offered.

If you give up during the game, enter 99. The program runs in 1k.

```
 10 RANDOMISE
 20 DIM A(35)
 30 FOR B = 0 TO 35
 40 LET A(B) = – 1
 50  NEXT B
 60  FOR B = 1 TO 4
 70  FOR C = 1 TO 4
 80 LET A(6*B+C) = 33+4*B+C
 90 NEXT C
100 NEXT B
110 LET B = 28
120 LET A(B) = 0
130 PRINT “1=EASY 2=NORMAL 3=HARD”
140 INPUT F
150 LET F = 200 + 150*(F=2) + 180*(F=1)
160 LET C = 0
170 LET D = RND(4)
180 LET E = (D=1)–(D=2)+6*(D=3)–6*(D=4)
190 IF A(B + E) < 0 THEN GO TO 170
200 LET A(B) = A(B + E)
210 LET A(B + E) = 0
220 LET C = C +1
230 IF C = F THEN GO TO 410
240 LET B = B + E
250 GO TO 170
260 CLS
270 PRINT “MOVE”;E
280 LET D = 0
290 FOR B = 1 TO 4
300 PRINT
310 FOR C = 1 TO 4
320 PRINT CHR$(A(6*B + C));“*”
330 IF A(6*B+C)=33+4*B+C THEN LET D=D+1
340 NEXT C
350 PRINT
360 PRINT
370 NEXT B
380 IF D = 15 AND A(28) = 0 THEN GO TO 550
390 PRINT “LETTER PLEASE?”
400 RETURN
410 LET E = 0
420 GOSUB 260
430 INPUT A$
440 IF A$ = “99” THEN STOP
450 FOR B = 7 TO 28
460 IF A(B) = CODE (A$) THEN LET C = B
470 IF A(B) = 0 THEN LET D = B
480 NEXT B
490 LET B = C – D
500 IF NOT(ABS(B)=1 OR ABS(B)=6) THEN GO TO 430
510 LET A(D) = A(C)
520 LET A(C) = 0
530 LET E = E + 1
540 GOTO 420
550 PRINT “WELL DONE”
560 RUN
```

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ADVERTISERS INDEX

AED 72
ASP Microcomputers. 37, 56
Alliance Computer Products 48
Anderson Digital Equipment. 72
Archives Computer Services 40
CGF Electronics 2
CISA Microcomputing. 68, 69
CW Electronics 74
Calculator & Computer Distributors .12
City Personal Computers. 16, 17
Commodore Information Centre. 4
Compshop. 94, 95
Comp-soft .20
Computer Galerie 100
Computerland (Australia) . . . . .IFC
Computers 2000 92
Creative Software 62
Deforest Software 54, 66
Electronic Concepts 34, 100
Embryonic Systems. 98
Imagineering 62
Informative Systems 26
KL Microsystems. 26
Kalyn Peripherals 99
The Logic Shop. 8
Lookey Video 44
Lothean. 81
MS Microcompilers 99
MS Software 74
Magnetic Media 85
Mensa Computers . . . . .IBC
Micro Base. 46
Micro Educational. 11
Micro Visions 44
Micro 80 53
Microcomputer House. 48
Microprocessor Applications 9
MIJO. 93
PIB Systems 98
Pitt St Micro 87
Ribbons Galore 92
Ritronics. .42
Seahorse Software. 87
Sinclair Equipment 88, 89
Dick Smith 31
Software 80. 97
Software Source 24
System Software. 48
TCG Ohio Scientific 28, 29
3M Australia 10
Zenith Education 76
Zofarry Enterprises. 58

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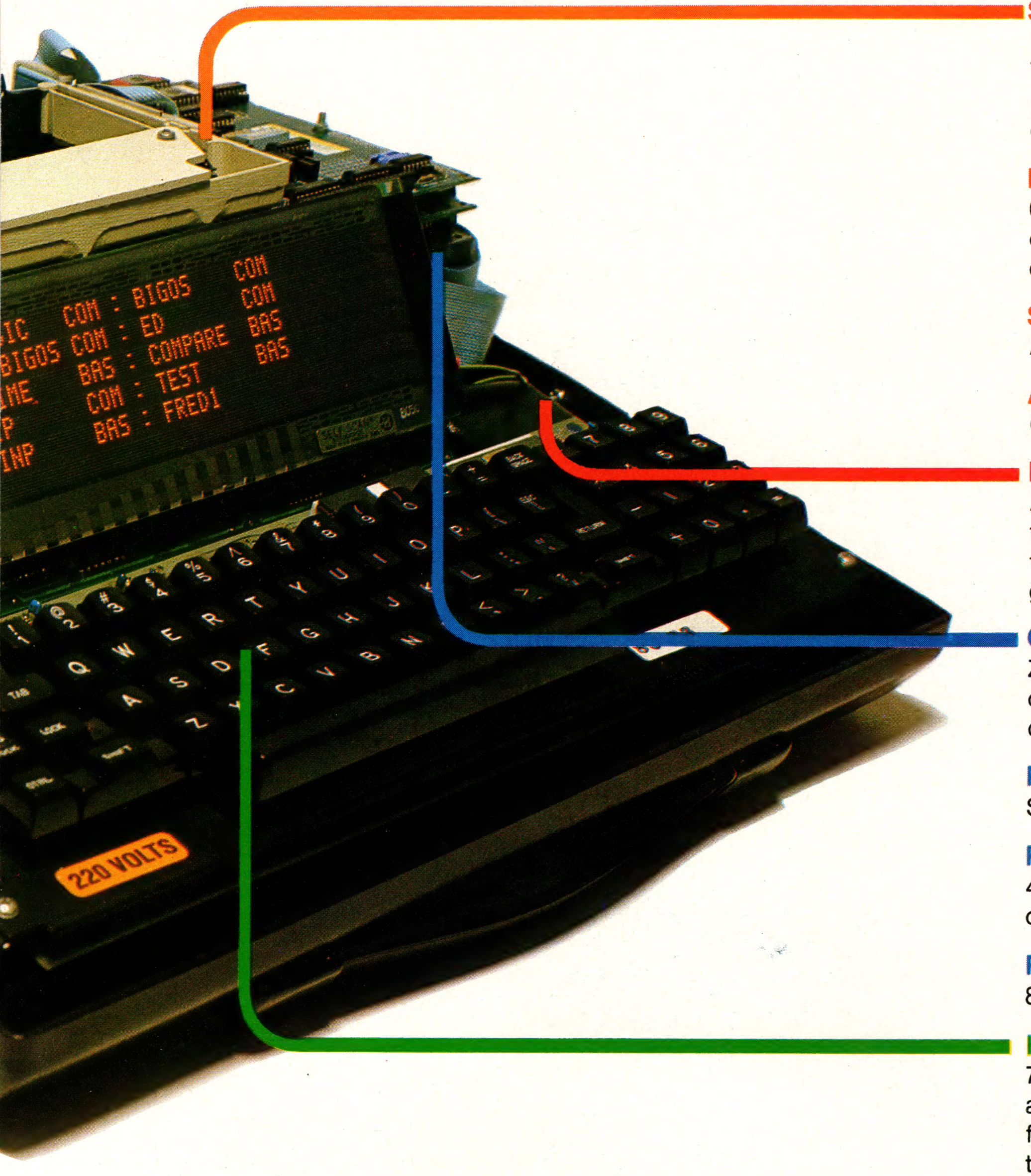

Serial I/O
Four RS-232C ports, one of which is also
TTY. 4 DB-25s connectors provided on ba
panel. Full interrupt capability with priorit
optional.

Parallel I/O
64 TTL lines, each can be either input or
output. Full interrupt capability, with prior
optional.

S-100 Bus Adaptor
Allows interfacing to any S-100 bus devic

Acoustic Coupler
Optionally built-in, 300 or higher baud rat

Battery (optional)
A continuously charged battery pack mai
tains the information in the RAM memory
the event of a temporary power failure an
gives one hour plug-off work capability.

CPU
Zilog Z-80 with 2.5 MHz clock (4 MHz
optional), 1.6 microsecond minimum add
cycle time.

Real Time Clock
Software interrupt settable and readable.

Random Access Memory
48k bytes of dynamic RAM, expandable t
over 2 megabytes. 1k bytes of static RAM

Read Only Memory
8k bytes of ROM. Expandable to 32k byte

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72 sculptured keys, alphanumeric, upper
and lower case, up to 35 programmable
function keys, ten-key numeric pad, elec-
tronic shift lock, all-caps lock, LED indica
N-key rollover, autorepeat.

Physical specifications
Size: 17½ x 21½ x 8½ inches
(44.4 x 54.6 x 21 cm)
Weight: 31 pounds (14 kg)
Case: high impact, molded Kydex
Temperature resistant: 32°-122° F
(0°-50° C)
Humidity resistant: 20-85% relative

Baud Rate
Up to 19,200 entirely under software control.

Peripherals
Standard floppy and large hard disc drives, printers, other computers. Asynchronous, synchronous or bisynchronous communications.

Electrical specifications
Power: 110/220V (optional),
± 15%, 47-440 Hz, 200 W max.

Mechanical specifications
Functions are modularized into separate
printed circuit boards connected by
STACKBD® , a proprietary interconnecti
scheme which eliminates the need for a
mother board. Board position and relative
order in the chain is arbitrary, and expans
is limited only by the physical size of the
unit and the electrical load capacity.

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isplay

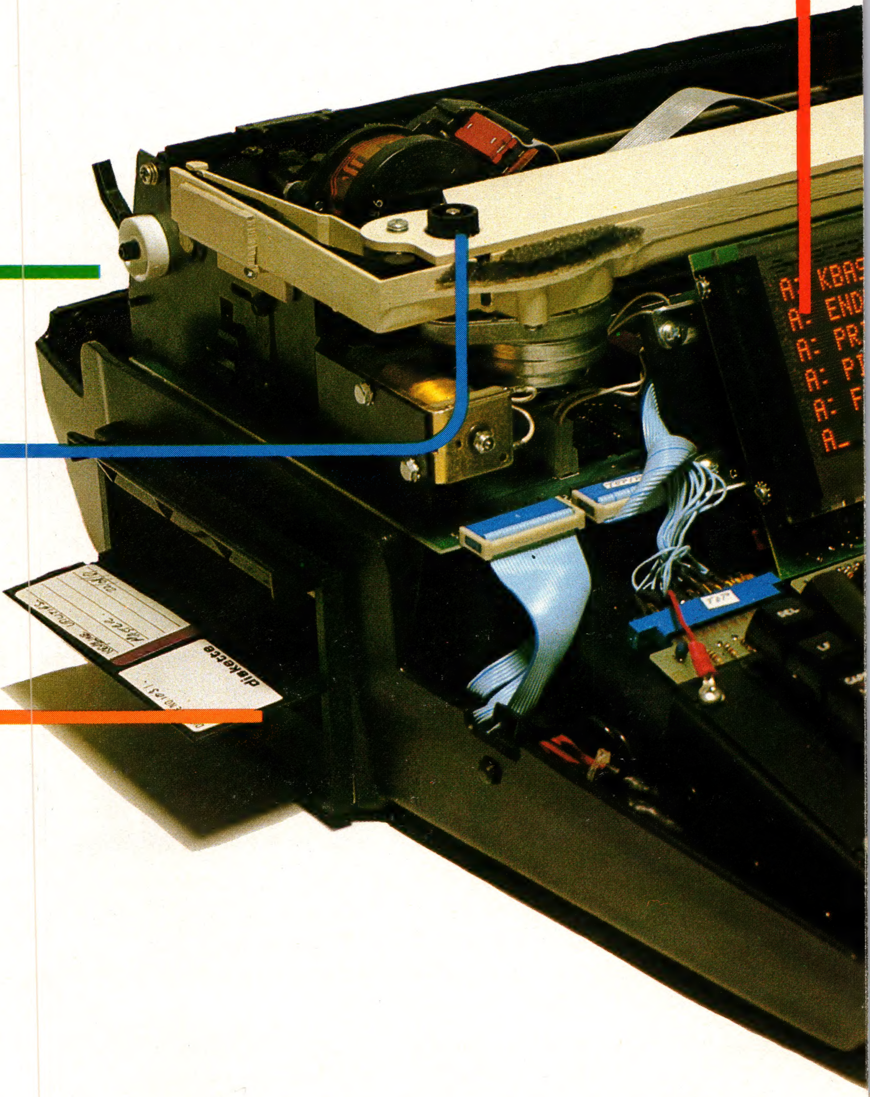
lat gas plasma display panel consisting of rows of 40 or 80 characters each, numeric nd upper and lower case alpha; 5 x 7 dot natrix. Micro-programmed cursor and scroll rotocols. Character set under software con- ol. Can be interfaced to full-screen CRTs, lthough most applications do not need a full creen as computer operators answer only ne question at a time.

udio (optional)

O in the form of two-tone audio, 100 bytes er second (1100 baud), is built in and avail- ble for data transfer to any standard cas- ette recorder.

rinter

), 80, 96, 132-columns per line, 25 lines/ iin. (Numeric, upper and lower case alpha haracters, and expanded print) Tractor &/or iction feed. Uses multi-copy plain paper, nd 5 x 7 dot matrix impact principle. haracter set, forms under software con- ol. Form width: 9 inches.



lass storage:

uilt-in mini-floppy diskette drive

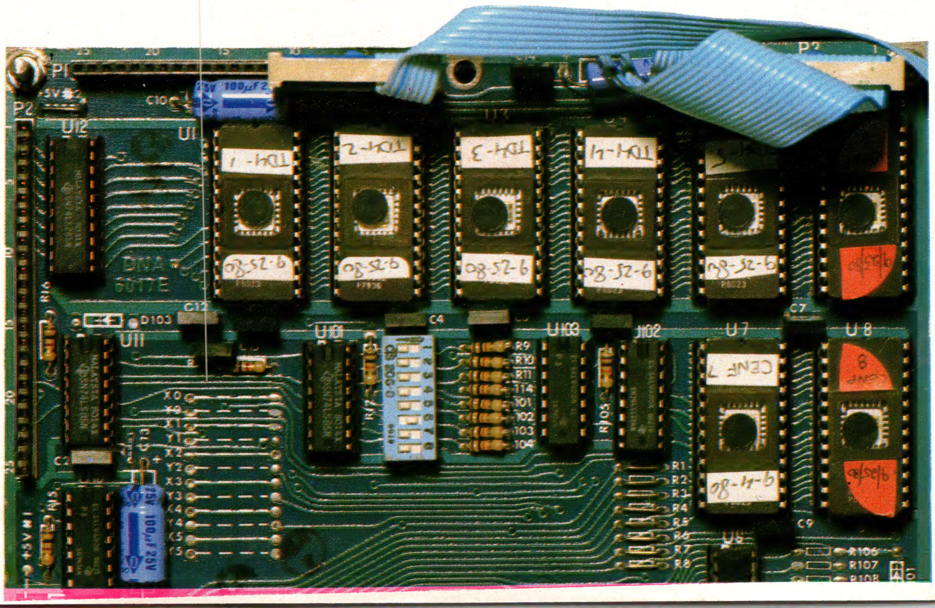
ystem 100TD includes one built-in mini- oppy diskette drive holding 200k bytes, ex- andable to 400k bytes. Access time: 40-75 iilliseconds. Option available for built-in ual mini-floppy disk drive.

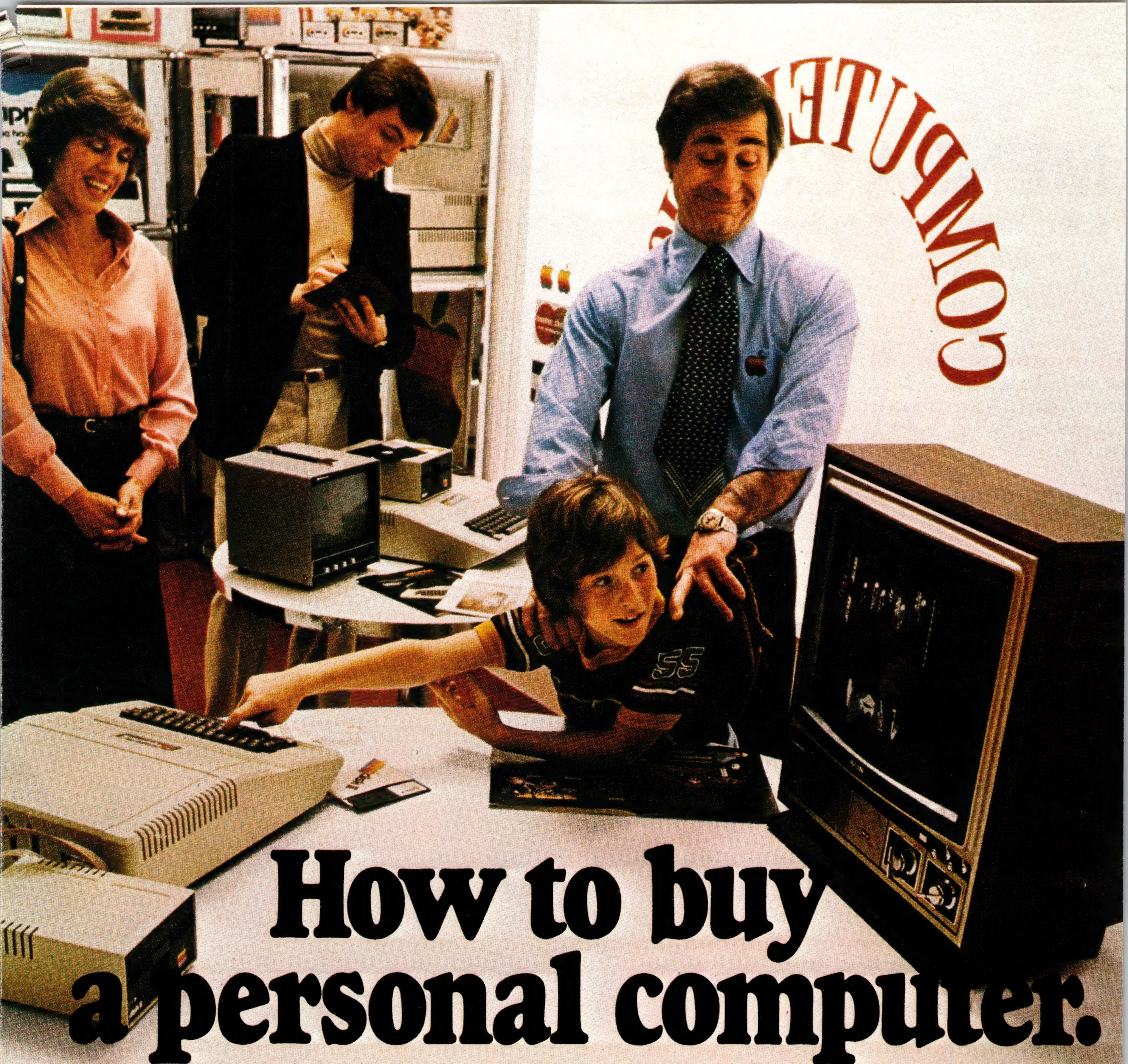
ubble memory

ystem 128TD uses 128k of bubble memory, xpandable to 2 megabytes on the same ontroller. (½ million only inside the case) ccess time: 8 milliseconds. Memory is etained even during power interruptions. o rotating parts.

lard Disk

ptionally 10, 39, 90 and 195 Megabyte rives available. Data transfer up to 2 legabytes/sec.





How to buy a personal computer.

In California, a store owner charts sales on his Apple Computer. On weekends though, he totes Apple home to help plan family finances with his wife. And for the kids to explore the new world of personal computers.

A hobbyist in Michigan starts a local Apple Computer Club, to challenge other members to computer games of skill and to trade programs.

Innovative folks everywhere have discovered that the era of the personal computer has already begun—with Apple.

Educators and students use Apple in the classroom. Businessmen trust Apple with the books. Parents are making Apple the newest family pastime. And kids of all ages are finding how much fun computers can be, and have no time for TV once they've discovered Apple.

Visit your local computer store

The excitement starts in your local computer store. It's a friendly place, owned by one of your neighbors. He'll show you exactly what you can use a personal computer for.

What to look for

Your local computer store has several different brands to show you. So the salesman can recommend the one that best meets your needs. Chances are, it will be an Apple Computer. Apple is the one you can program yourself. So there's no limit to the things you can do. Most important, Apple's the one with more expansion capability. That means a lot. Because the more you use your Apple, the more uses you'll discover. So your best bet is a personal computer that can grow with you as your skill and involvement grow. Apple's the one.

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